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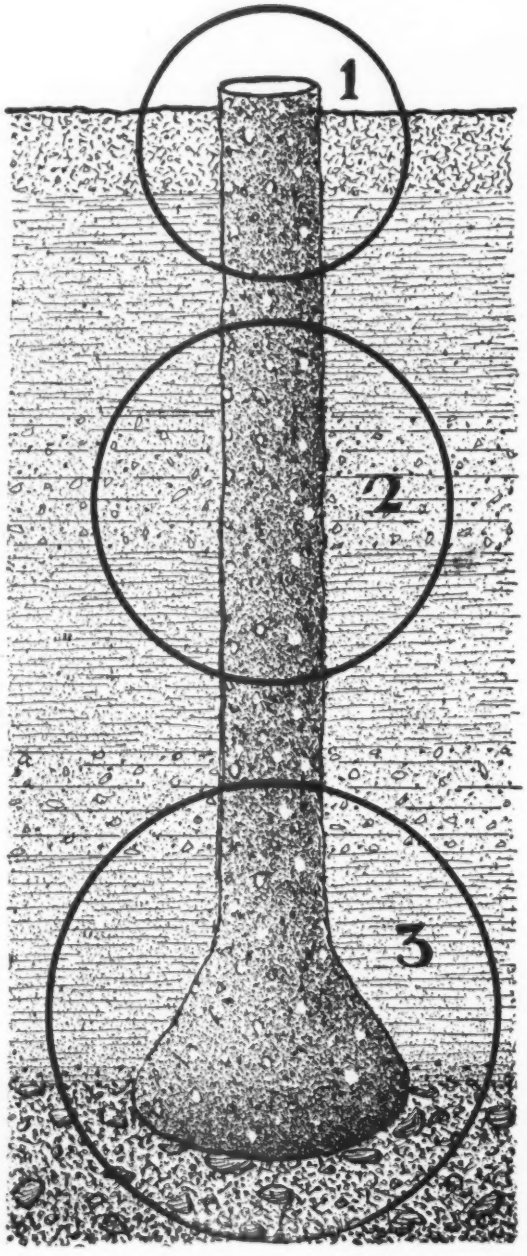
Is An Unyielding Foundation the First Requirement for Asphalt?

In this issue Lester Kirschbraun, Director, Chicago Paving Laboratory, Discusses Some of the Advantages of Bituminous Concrete Foundations for this Type of Pavement.

Cover Released by Courtesy of Jamison Wright Co., Toledo, Ohio.

How Treacherous Soils are Conquered by PEDESTAL PILES



A surface soil, then several strata of poor materials, finally the firm subsoil; surely this is so usual an example of difficult foundation conditions that it may be called typical. Now note how the Pedestal Pile overcomes these conditions:

1 At the surface the Pedestal Pile receives the load on its 16 in. diam. cylindrical stem—a stem straight and true which retains its full diameter throughout its length.

2 Through the varying soils this shaft transmits the load like a column with surface just rough enough to develop all the friction possible from the surrounding soil.

3 On the subsoil rests the large spread base about 3 ft. in diameter distributing the load like a column footing over the firm and compacted soil.

The bearing capacity is comparable to a grillage—but the cost is that of a concrete pile.

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Engineering News-Record

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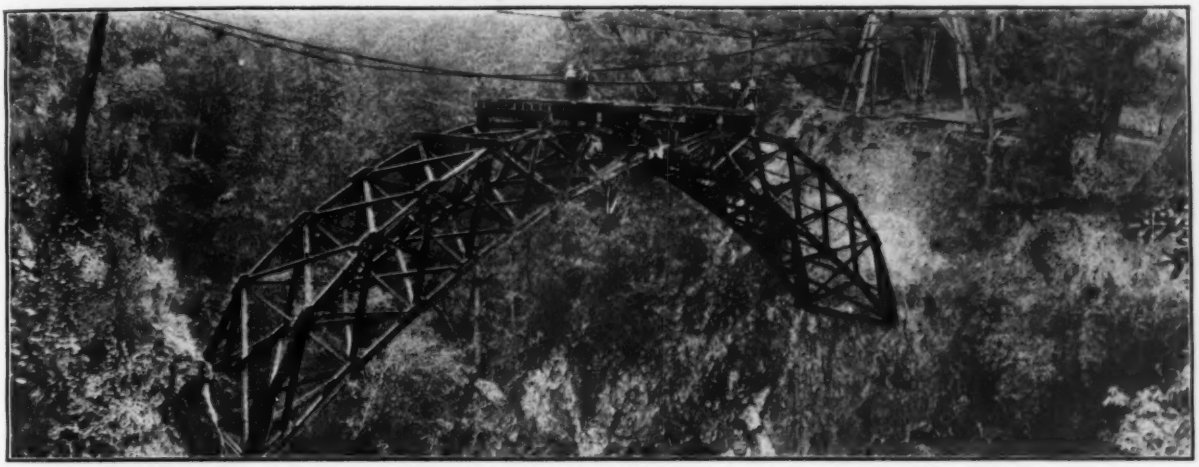
Three-Hinged Arch Highway Bridge Built of Timber

Redwood Most Economical Material at Remote Site—Design Favors Low Cross-Bending Strength—Arches Erected by Overhead Cables



By F. W. HASELWOOD

Assistant Division Engineer, Division I, California Highway Commission

IN COMPLETING that part of the California state-highway system which will provide a route open all the year round from San Francisco to Eureka, a 40-mile section of the line is being built in northern Mendocino County through extremely rough country. The topography is probably more broken than that of any section of the state through which the commission has heretofore located a through line. In fact, the commission has chosen this work as the location for the convict-labor camps, because this represents the most inaccessible region in which roadwork is under way. One of the notable features of the line through this broken territory is the large number of bridges required across rivers and deep gorges.

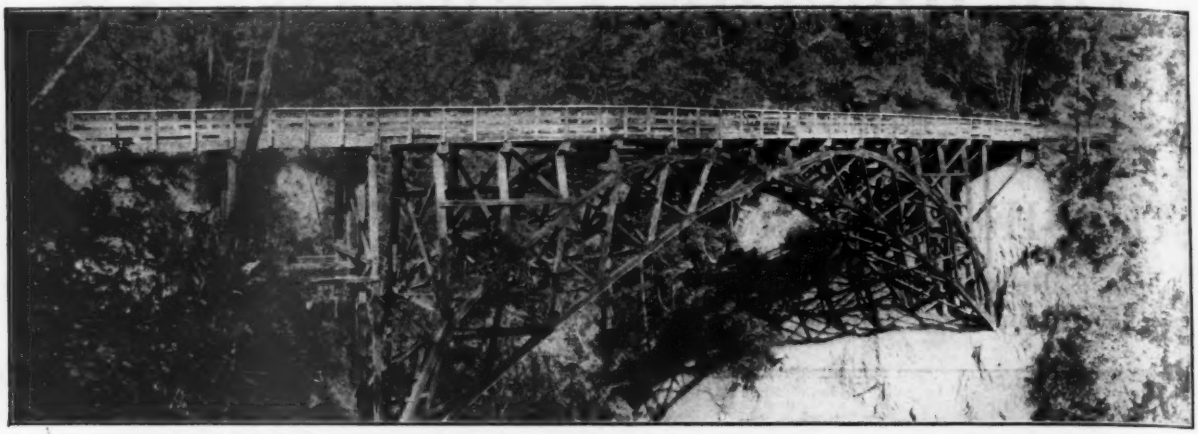
The Rock Creek bridge, the first of these structures to be completed, has a span of 150 ft. with a rise of 42 ft. The total length, including approaches, is 232 ft., and the floor of the bridge is 150 ft. above the bottom of the gorge. The roadway, which is 18 ft. wide, has a 4-in. redwood plank floor, which will be covered with ½ in. of asphaltic wearing surface when the line is ready for traffic.

A Design Suited to Soft Wood

In deciding upon the type of structure to be built at this point, steel and concrete were eliminated at the outset by the long and expensive haul over steep narrow roads and the scarcity of sand and gravel. A good stand of redwood timber was available about two miles from the site, which could be secured for about $2 per 1000 ft. b.m.; and considerable timber was also available along the right-of-way.

Redwood is heavy when green, lighter than pine when dry, shrinks but little in seasoning and in the shape of bridge timbers can be used safely immediately after being cut. Its strength is about 30% less than that of pine, and its weakness in resisting stresses normal to the grain is an important factor in designing. It was estimated that, if the structure were built of redwood, its life would be from 20 to 30 years. The load requirements were 100 lb. per sq.ft. of roadway for the arch, and for the floor 15 tons on two axles, spaced 10 ft. apart, 10 tons being carried by the rear axle. With these conditions the results of the study made were favorable to the use of redwood. The unit stresses used in the design of the structure were then worked out on the following basis: Tension or compression in bending, 1100 lb. per sq.in.; compression in columns $1100 - \left(1 - \frac{L}{60d}\right)$; compression perpendicular to the grain, 200 lb. per sq.in.; shear parallel to the grain, 80 lb. per square inch.

The next problem to be considered in the design was the one of erection. From the outset it seemed very desirable to avoid the use of falsework, which would have been expensive and difficult to erect at this point. The two other methods considered practicable were cantilever erection or placing the trusses from overhead cables. The latter was chosen as being the most applicable to this particular case. Local conditions, the material to be used and the erection method all suggested some type of arch.



THE ROCK CREEK BRIDGE, OF REDWOOD, HAS AN ARCH SPAN OF 150 FT. AND A TOTAL LENGTH OF 210 FT.

Plans for a deck Howe truss having a 180-ft. span were abandoned because the bearing perpendicular to the grain necessitated the use of such large castings and bearing plates that the cost of delivering these parts to the site would have been excessive.

The type finally selected was a three-hinged arch with crescent-shaped trusses for ribs. These trusses are 15 ft. apart at the center pin and 28 ft. apart at the foundations, braced with top and bottom laterals and sway braces. This bracing was calculated for a wind load of 300 lb. per lin.ft. of bridge on either chord, although the bridge is so well protected that there will be practically no wind load and the bracing will be useful for resisting vibration only.

Shape of Trusses Determined Graphically

The shape of the trusses was determined graphically by drawing funicular polygons for the extreme conditions of loading. The chords were then located outside these polygons in order that no condition of loading would put members in tension. It was necessary to design the joints to take tension, however, particularly those of the lower chord, in order to take care of the erection stresses. The dead-load and full live-load stresses and the positions of the live load for the maximum and minimum stresses in the various members were determined graphically, the maximum and minimum stresses being the algebraic sums of the dead and live loads.

The chords are made up of 12 x 12-in. timbers. The lower chord has only three splices, while the upper chord is spliced at each panel point. These panels are 10 ft. apart horizontally and are the points of support for the bents that carry the floor.

The foundation pins were designed to rest on concrete blocks, the bases of which are normal to the line of the full-load reaction. Indications were that the foundations might safely be relied upon to carry 4 tons per sq.ft. When the excavations were made, the footings proved to be in such hard rock that only enough concrete was used to make a suitable bed for the castings, holes being drilled in the rock for anchor bolts.

About 90,000 ft. b.m. of lumber was required for this bridge, and other structures also to be built of timber on this same section of the highway brought the total required up to about 500,000 ft. b.m. This was considered sufficient to warrant the installation of a portable sawmill. A mill was accordingly brought in which was operated by a 35-hp. gasoline engine and was equipped with a trailer so it could square logs up to 60 ft. in length. From 4000 to 6000 ft. b.m. per day was turned out with this equipment.

Trusses Placed by Cables

Gallows frames supported by two 1⅜-in. plow-steel cables were erected at each end of the bridge, their span being sufficient to allow the completed trusses to pass beneath them. A hoisting engine was located at the north end about 100 ft. back of the gallows frame, and this engine was used to handle the timber brought across on cables from the sawmill on the south bank. The north and south halves of the bridge were erected on their respective banks, immediately behind the gallows frames.

On the north bank the entire half-section of the bridge was built in one piece and placed on its foundation bodily. This was accomplished by picking up the forward end on two carriers traveling on the large cables while the rear end traveled on rollers and was snubbed to a tree to prevent too rapid movement. A ⅝-in. line from the steam winch drew the suspended section forward until the rear end was under the gallows frame. The forward end was then fastened directly to the carriers and the tackle released, after which the rear end was picked up

HOW THE SOUTH HALF OF THE ARCH WAS LOWERED INTO POSITION BY THE GALLOWS FRAME

from the gallows frame, the arch moved forward until it cleared the bank, and the rear end lowered into position on the foundation pins.

Guy lines of ¾-in. cable, attached to the forward end, were passed over the frame and fastened to deadmen, thus releasing all weight from the suspended cables. These guy lines were so adjusted that the center pins were at their proper elevation. The greatest load on any single suspended cable at one time was 12,000 lb. Trusses for the north half were taken out separately and supported by the cables until the pins were put in place, after which the lateral and sway bracing was placed.

REDWOOD TIMBER FRAMING DETAILS

The bridge was given a camber of 1 ft. beginning at the shore ends of the approaches. The length of the posts for the bents was determined by obtaining the elevations of the supporting blocks at the panel points. Erection of the bents and construction of the floor were started at the center, the corresponding bents on either side being set up at about the same time.

The bridge is now in use by construction crews, and timber for other structures is being hauled across it on a large logging truck. It will not be open to the public until the completion of this section of the highway early next summer. Painting has been deferred until next season in order to give the timber opportunity to dry out. Joints into which water might find its way and cause decay have been filled with hot asphalt.

Austin B. Fletcher is chief engineer of the California State Highway Commission. Francis G. Somner is division engineer. The construction was carried out on the day-labor plan under the supervision of F. L. Smith.

Canal-Zone Health Conditions Improving

During the week ending Apr. 21, 1917, there was not a case of an employee of the Canal or Panama Railroad on the Isthmus being admitted to sick report for malaria. This was the first time in the history of the Canal that a week has passed without the occurrence of malaria among the employees. It has occurred several times that either the Zone or the terminal cities had no cases, but this was the first time that no new cases had occurred in a week in both the Zone and the terminal cities.

The number of admissions from malaria in March was 23; in February, 18; and in January, 31. The average per day to the first of April was 0.8, which is equivalent to 5.6 per week. In the calendar year 1916 the number of employees treated for malaria was 547, an average of 10.5 per week.

Railway-Tunnel Concrete Softened by Locomotive Gases

Lining of Cascade Bore of Great Northern Shows Disintegration, Due Probably to Sulphur from Locomotives

A SUSPICIOUS disintegration of the concrete lining in the Cascade tunnel of the Great Northern Ry. led some time ago to a study of the conditions there and to the subsequent investigation of the Seattle tunnel on the same road. It was found that in both tunnels there was a disintegration, which might be characterized as progressive, taking place in the concrete structure of the lining—a disintegration that, according to the investigator, is probably due to the chemical combination of the sulphur in the locomotive gases with the cement in the concrete. The case is reported in a paper before the Pacific Northwest Society of Engineers by Charles A. Newhall, of Seattle.

Lining Completed in 1899

The Cascade tunnel is one of the earliest, if not the earliest, railway tunnels to be lined complete with monolithic concrete. The work was finished in 1899 and was apparently in satisfactory condition until about 1915, when it was reported that pieces of soft white concrete had been found on the tracks or on trains that passed through the tunnel. A general survey then showed that concrete had disintegrated in places, these places being scattered throughout the entire length of the tunnel, though in no instance was the disintegration serious enough to impair the strength of the lining.

The disintegration was apparently of two distinct types. In one type the concrete softened and became mushy, without swelling or without the formation of any extraneous matter. This condition was apparently due purely to porosity in the concrete and the removal of the cement by water flowing through it. It is stated by Mr. Newhall that the disintegration is due to the carbon dioxide in the water combining with the calcium compounds in the cement to form a calcium bicarbonate, which is quite soluble and easily washed away.

The second and more important disintegration, which has been designated the "sulphate disintegration" to distinguish it from the first, was always accompanied by a swelling of the concrete and the formation of a white mud abnormally high in sulphate content. The scaling here is in small patches up to about ½ in.; in the large areas 2 in., and in a few places to a greater depth. In these softened places the concrete resembles a soft lime paste, in which are embedded pieces of coarse and fine aggregate. In other places the softened section has the appearance of a great open boil, the concrete being bulged out over an area of a square foot or so, out of the center of which oozes a white limelike mud.

Theory of the Disintegration

It was the theory of the investigator that this disintegration was due to the combination of the sulphur from the locomotive gases with the cement. It was found that no such action had appeared in the Cascade tunnel until it was about 16 years old, although some suspicious action had apparently developed about five years before

On the supposition that the sulphate disintegration should become apparent to the eye only after some 10 or 15 years of time, the Seattle tunnel, which was then just 11 years old, was examined for possible similar trouble.

Although a preliminary trip through the Seattle tunnel showed only slight disintegration of the characteristic sulphate type, a detail inspection with soundings opened up other spots where disintegration was in progress. As in the Cascade tunnel, it was accompanied by the formation of the characteristic sticky, white mud abnormally high in sulphur, and the affected areas were practically the same in appearance, so that it was very clear that the presence of water was essential to the development of the disintegration.

The source of the sulphur was laid to the sulphurous gases from the locomotive fuel. The sulphur from this fuel when burned is oxidized, escapes from the locomotive stack along with other gases and with steam, which gives the necessary water. It is eventually changed to sulphurous and sulphuric acid. These acids condense on the walls and arch of the tunnel to react with the lime and cement to form calcium salts and eventually in the presence of water to crystallize as gypsum. The gypsum enlarges in cracks that may form from one cause or other and, in swelling, breaks off the concrete with the characteristic disintegration. It was found in both tunnels that the water back of the tunnels where it existed had no sulphur content or alkalinity, so that the disintegration could not be blamed on that cause.

Repair Riprap on Reservoir Slope

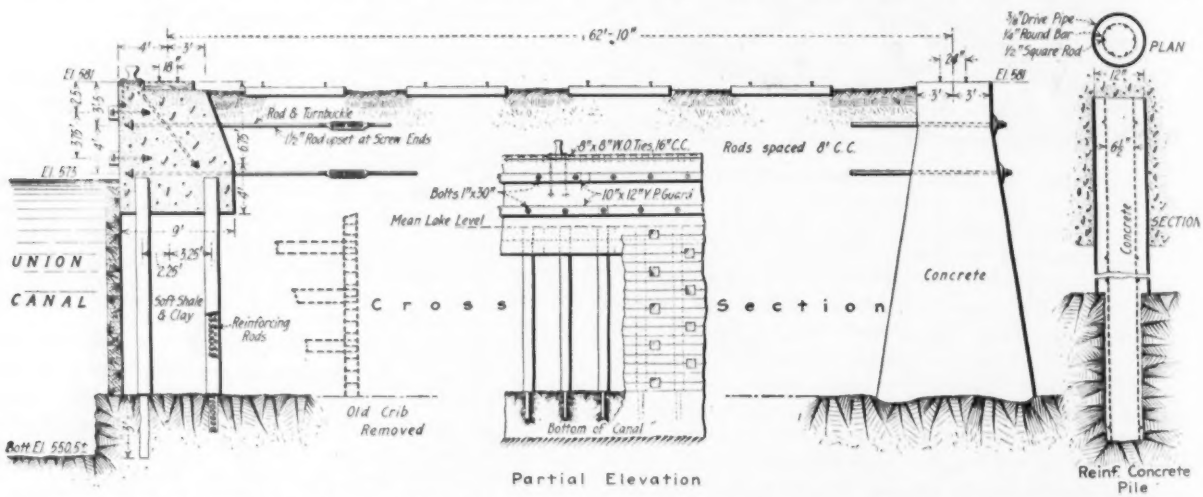
Part of the original riprap on the Piute reservoir, storing water for irrigation near Junction, Utah, yielded to wave action during the high winds in the spring of 1916. "The repair of the riprap has been in progress by force account practically all winter," writes J. L. Rhead. "The renewed riprap consists of roughly quarried porphyry blocks 20 in. deep, laid as close together as possible on a 14-in. layer of gravel that passed a 6-in. mesh screen and was retained on a ¾-in. mesh. So important is it that the water be saved for the irrigationists that, as a matter of precaution, armed guards patrol the reservoir property."

Concrete Bulkhead Wall Replaces Old Timber Structure

Bulging Crib on Buffalo Canal Rebuilt as Concrete Wall on Concrete-Filled Iron Pipe

AN OLD timber-crib bulkhead wall along the Union canal, at South Buffalo, N. Y., has recently been replaced in novel fashion by a concrete wall resting on piles made up of wrought-iron pipe filled with concrete. The original bulkhead, a timber superstructure resting on cobhouse cribbing, also of timber, was showing signs of wear and in particular had bulged below the water line for a distance of 60 ft., for a total depth of bulge of from 2 in. to 3 ft. Furthermore, the superstructure all the way along the wall was in very poor condition and needed replacement.

The bulkhead wall as originally built in 1903-04 was a stone-filled timber-crib superstructure built in the dry



OLD TIMBER DOCK WALL AT UNION CANAL IN BUFFALO IS REPLACED BY CONCRETE WALL ON SPECIAL PILES

and in place, so as to provide a channel depth of 22½ ft. The cobhouse timbering was uniformly 20 ft. wide and the substructure of varying depths, depending on the height of the rock berm of soft shale rock upon which it rests. This superstructure was 8 ft. above the lake level, the maximum height to which the eastern end of Lake Erie rises under pressure of an east wind. About 75 ft. shoreward of the timber dock wall is located an iron-ore storage basin, where ore unloaded from vessels in the canal is transferred by a Hulett unloader and two Brown hoists, either directly to cars or to the basin. The weight of the forward trucks of these machines, amounting to 324,000 lb. in the Hulett unloader and 189,000 on the Brown hoists, is carried by the outer edge of the canal-wall superstructure on a track of 18-in. gage. The center line of this narrow-gage track is located 4 ft. in from the face of the pier.

Ordinarily, cribwork of this character is filled with hard filling stone, but in the absence of this the soft shale encountered in the bottom part of the excavation was used in the early work, together with the small amount of earth with which it was naturally mixed. Owing to the lesser weight of this filling material and to afford sta-

bility and to prevent movement of the cribwork, a line of anchor rods 3½ ft. below the top of the superstructure and on 8-ft. centers was provided. These rods were 1¼ in. in diameter and extended from the water face of the cribwork to the inside face of the concrete retaining wall of the iron-ore storage basin.

On account of the bulging of the wall and also on account of decay, the superstructure was replaced by a concrete dock wall supported on piles driven through the fill of the old lower cribs and provided with tracks for the railroad and the outer trucks of the unloaders.

The accompanying drawing gives a cross-section of the dock wall and shows the subaqueous position of the timber cribwork along the Union canal, also the concrete retaining wall forming the south side of the iron-ore storage basin. Only a portion of the old cribwork is shown, but enough is given to make clear the original construction.

How the Rebuilding Progressed

The method of reconstruction was first to saw out the connecting timber ties of the cribwork, removing the filling with a clamshell dredge. The removal of the timber ties with the old filler material alternated until a depth of about 3 ft. below water level was reached.

The piles were then driven. These were made up of 12-in. casings, or wrought-iron pipe, which were driven by an ordinary floating piledriver through the filling stone of the cribs to the bedrock upon which they rested. These pipes, which are made of ⅜-in. metal, average in length about 17 ft. 9 in. No difficulty was experienced in driving them, due no doubt to the disintegrated character of the filling.

There are two lines of these pipes, located 3 ft. and 8½ ft. back from the front face of the wall and placed on 4-ft. centers longitudinally. In driving them a special cap fitting the top of the pipe was used. After the pipe had been driven to bedrock, each was thoroughly cleaned out by means of a water jet. Holes were then drilled below the pipe into the underlying rock by steam drills. These holes are 6 in. in diameter, 5 ft. deep in the front row and 3 ft. deep in the back row. After they had been cleaned out by the water jet, they were reinforced and filled with concrete. The front row was reinforced with an old rail, and the back row with a special reinforcing consisting of six vertical square rods wired by ¼-in. round bar hoops at 3-ft. intervals.

On this row of piles the concrete superstructure was built in 50-ft. sections, the forms being of the usual wooden type, in which the sides extended into the water to a depth of 3 ft. To prevent leaks of the cement from the underwater concrete, the bottom was covered by a layer of muslin. This superstructure was then tied back, as shown in the drawings, to the concrete retaining wall, the fill replaced and the tracks laid. Up to the first of May, 600 lin.ft. of new concrete superstructure had been completed, of which half was built March-May, 1916, and half January-April, 1917.

The restoration of the dock was carried out by C. P. McArthur, principal assistant engineer, northern division—Buffalo division, Pennsylvania R.R. The contractor for the work was the Great Lakes Dredge and Dock Co., of which Frank C. Hibbard is general manager.

New York Adopts Rules for Sewage Works and Outlet Design

Grit Chambers, Screens, Sedimentation Tanks, Hydraulic Grades and Outlet Locations Are Covered

AFTER mature deliberation the Board of Consulting Engineers of New York City submitted to the Board of Estimate and Apportionment, through Nelson P. Lewis, chief engineer, 14 rules to govern the design of sewage-treatment works and outlet sewers. The rules were adopted early in 1917. They have since been published, with explanatory remarks, in a pamphlet issued by the board and also in the May number of the journal published by the municipal engineers of the City of New York. The rules follow:

1. The volume of sewage intercepted to treatment plants shall be:

(a) For separate systems, the maximum flow.

(b) For combined systems:

(1) To grit chambers, three times the mean dry-weather flow, where grit chambers only are to be provided; elsewhere, the capacity should be equal to that of subsequent treatment processes.

(2) To fine screening plants, three times the mean dry-weather flow, except in those cases where the cost of interception and pumping would be excessive, in which case the volume shall be limited to two times the mean dry-weather flow.

(3) To sedimentation plants, two times the mean dry-weather flow.

Interception of Sewage

2. The interception of sewage should be controlled to within 20% of the assumed intercepted flow.

3. Outlet sewers shown on drainage plans, where it is proposed to treat sewage by screening, should provide for a loss of head for the operation of the screens as great as 1 ft., where practicable.

4. For all but exceptionally large sedimentation plants, such as have been proposed for Barren, Ward's, and Riker's Islands, a loss of head due to the flow through the plant amounting to 1 ft. shall be provisionally assumed.

5. The methods of sampling and analyzing sewage and sewage effluents to determine the results of processes for treatment shall be those adopted by the American Public Health Association.

6. Outlet sewers shall be constructed at as high an elevation as is consistent with proper gradients and adequate drainage.

Hydraulic Grade

7. The hydraulic grade at the outlet shall be assumed, in the design of the outlet sewer, to be not lower than the level of mean high tide, except where the top inside of the sewer is submerged more than 20 ft. below the elevation of mean high tide, in which case the hydraulic grade shall be assumed to be not lower than the level of mean high tide, plus 0.15 ft. for every 10 ft. of submergence.

8. If the sewage is delivered by gravity to a fine screening plant having screens of the Riensch-Wurl type, or to a

sedimentation plant, and thence to the outlet, the hydraulic grade at the outlet in the harbor during periods of maximum sewage flow shall be assumed at 35% of the mean tidal range at that point above the level of mean high tide. The upper ends of Hamburg or other band screens can be carried sufficiently high to avoid drowning out during high stages of tide and so can be designed with the hydraulic grade at outlet at the level of mean high tide.

9. If the sewage is pumped to a fine screening plant having screens of the Riensch-Wurl type or to a sedimentation plant, the hydraulic grade at the outlet in the harbor during periods of maximum sewage flow shall be assumed at not less than 50% of the mean tidal range at that point above the level of mean high tide.

10. Effluents from fine screening and sedimentation plants shall be discharged at or beyond the pier-head line when practicable.

11. In establishing the hydraulic grade of the sewage entering a screening or sedimentation plant from which the effluent passes by gravity to the outlet there should be added to the hydraulic grade at the outlet (as given in Rules 8 and 9) the head lost in the outlet sewer between the plant and the outlet at times of maximum flow, plus 1 ft. loss of head in passing through the plant.

12. Where separate or combined outlet sewers constructed under piers are not to be submerged or built beyond the end of the pier, the outlet should be carried to a point within 30 ft. of the end of the pier.

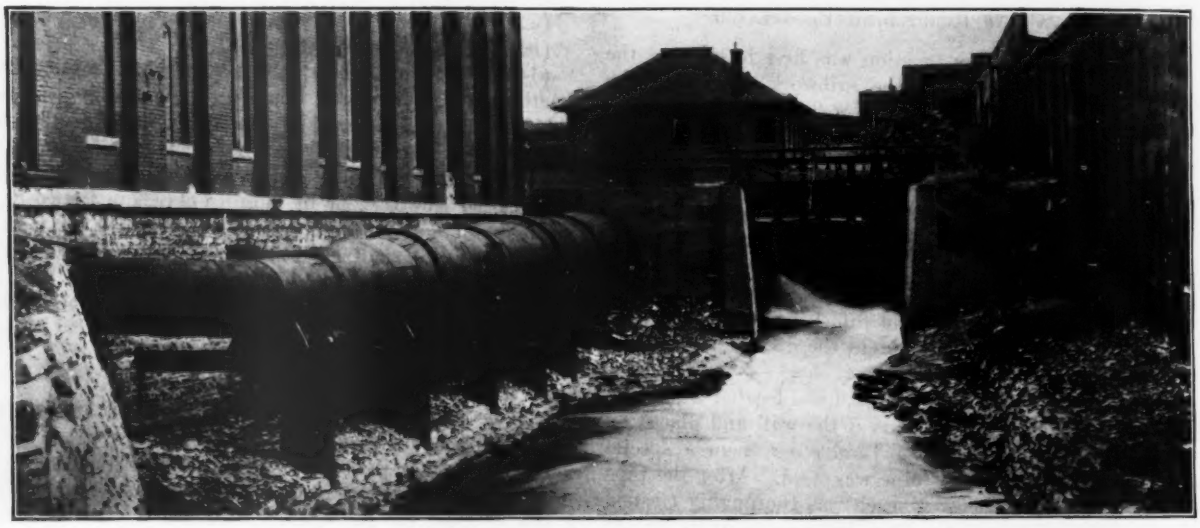
13. Where the submerged outlet sewer extends beyond the pier head, it shall be laid so as to avoid obstruction to either the actual or the legal channel or waterway and so as to avoid injury by dredging operations or the dragging of anchors. Where this condition can be fulfilled, the discharge shall be approximately in a horizontal direction; otherwise, in order to bring the outlet above the stream bed, the pipe may terminate in a bend.

14. Wherever practicable, submerged outlets shall be placed not less than 50 ft. beyond the pier-head line nor in less than 30 ft. depth of water over the top inside at mean low tide.

Levee Improvements Shut Down Pumping Station Two Months

Water Company Will Reclaim Canal Bed by Filling and Bringing Supply to Turbine in Closed Conduit

CLOSURE of the White River levee in Indianapolis in front of the Washington St. pumping station of the Indianapolis Water Co. will require that station to be shut for a period of two months. Incidental to the river protection, which will consist of a concrete retaining wall 40 ft. high joining the concrete pump well as shown in the drawing, the company will make other improvements to the flume and wasteway of the water-power end of the plant. The discharge from the draft tubes is to be confined in a closed concrete tailrace conduit 47 x 8 ft. in maximum cross-section to the levee wall, where it will be split up into six outlets. At times of flood the conduit, which will have an earth cover of 8 ft., will be subject to a maximum pressure from the river of 23 ft.; but with the water turned on from the canal, there will always be 6 to 7 ft. of positive head on the turbines.

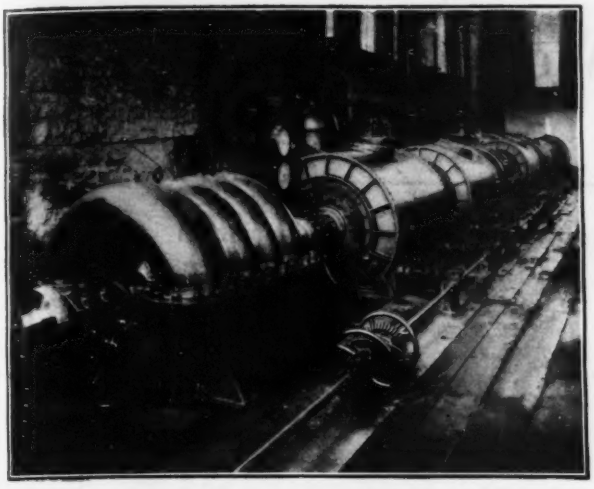


THE IMPROVED TAILRACE WILL BE ENTIRELY COVERED

Canal Levels Combined

Twelve years ago the use of water direct from the then lower level of the canal was discontinued for power purposes, both levels being combined at a point 1000 ft. above the station at Market St., the water being brought to the six pairs of 175-hp. turbines, driving the three four-stage 5,000,000-gal. De Laval centrifugal pumps, in a ¼-in. steel pipe 9 ft. 8 in. in diameter. However, the overflow from the forebay was still allowed to traverse the canal and discharge over a weir into the tailrace.

The present head on the turbines at this station is 31 ft. The closed tailrace improvement will increase this to a total of about 36 ft., which, in connection with the new pure-water conduit line now under construction, will make it possible to pump approximately 50% of the total requirements of the city at this station.



LEVEE IMPROVEMENT WILL PREVENT FLOODING OF TURBINE-DRIVEN PUMPS

It is the plan now to fill the old lower level of the canal its whole length, thus making available much valuable land. It will also eliminate three street bridges and take care of the overflow by a reinforced-concrete conduit 5 ft. in diameter. As the steel pipe is to be buried and must stand a maximum backfill load of 5 ft., it is to be covered with a shell of reinforced concrete, 9½ in. thick, except under roadways, where it will be 14 in. thick.

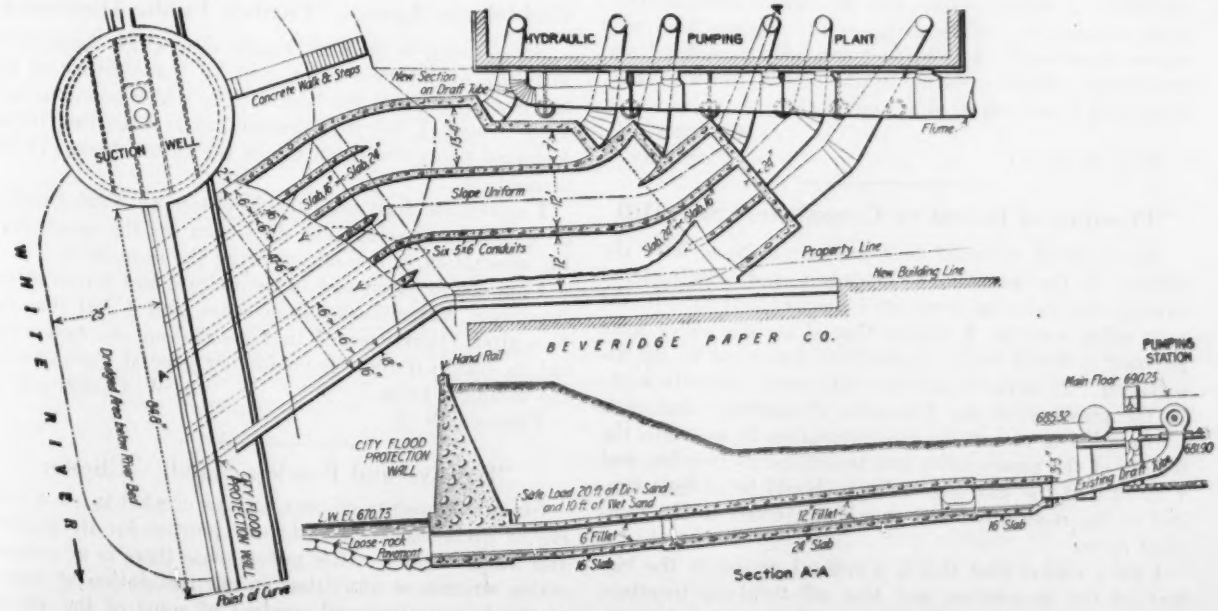
Nine New Bridges To Go In

Along the line of this same canal are nine street bridges, over which the city and the water company have been at litigation as to which should bear the cost of rebuilding. Recently the courts have decided that the company had to maintain the bridges. Of these the one at West St. is 120 ft. wide and 50 ft. in length. The two 20-ft. spans rest on a center pier. On account of the lack of headroom they will be made as shallow as possible. Under the two, street-railway tracks will be laid, 18-in. steel box girders embedded in concrete of a total depth of 25 in. The roadway slab will be 22 in. thick, and the 20-ft. sidewalk slab will be 8 in. thick with five T-beams 16 in. deep. None of the other bridges will carry street-car tracks, but the same attention to headroom must be observed.

The work was planned under the direction of C. H. Hurd, vice president and chief engineer of the Indianapolis Water Co., before he resigned to become the third member of the Sanitary Commission, which is authorized to build sewage-disposal works for the city. Construction is now being supervised through the office of Mr. Hurd as consulting engineer.

Canadian Government Tests Road Materials

It is everywhere apparent that road builders must use local rock and gravel wherever practicable this year, not only because the cost of commercial supplies will be high, but also because rail shipments of all building and construction materials seem destined to suffer more or less delay in order that food and munition supplies may have right of way. For this reason the geological departments of the different states can render valuable public service by publishing whatever information they possess regarding local rocks and gravels. Some have already done so, but few have gone into the subject with the thoroughness marking the work of the Canadian Department of Mines. In the summer of 1914 it began the investigation of road materials along certain waterways on which they could be shipped cheaply and along certain of the more important proposed highways. This work has been continued since then, with the result that there is a good knowledge of the local resources for road construction in parts of three provinces where such work is most active. The rock-testing methods developed by the United States Office of Public Roads are employed in the laboratory.



SUBMERGED DRAFT TUBES WILL BE EXTENDED IN CONCRETE CONDUIT TO LEVEE

The American Water-Works Association
—*As Its Members See It*

Letter Sent to Members of American Water-Works Association

Sir—The attendance at the meeting of the American Water-Works Association at Richmond was so small and so many vital things came up that should be given immediate and thoughtful consideration by every member of the Association that we are sending you a reprint of our story of the convention. There is all the more reason for doing this because some of the most important discussions took place when only a fraction of the small number who went to Richmond were on the convention floor. Even if you heard all the discussions relating to the business affairs of the Association you may be glad to have a concise review of their leading features.

With the story—entitled "Wash Linen at Water-Works Convention"—we are also sending you an editorial from our issue of May 17 headed "Revolution or Reform in the American Water-Works Association?"

To our minds, this is a critical period in the history of the American Water-Works Association; a time when full and free discussion would crystallize the opinion of the Association as a whole and be of great assistance to the Executive and other committees in formulating the policy of the Association for the current year and in framing amendments to the constitution.

Please let us have your ideas as to what changes, if any, are needed to make the Association more useful to its members and to the public; more efficient and thoroughly democratic.

EDITOR *Engineering News-Record.*

Secretary Diven Says "Unwarranted Interference"

Sir—I consider your action an unwarranted interference in the affairs of the association. The public press is no place for such discussions and I believe that your course will bring great injury to the association. A committee has been appointed to consider amendments to the constitution and to report to the Executive Committee, which committee is to then submit the matter to the members—a much better way to handle such matters than through the public press, as the matters submitted to the membership will be first carefully considered and condensed. Early agitation of the matter can work only harm and I am surprised at your action.

J. M. DIVEN,
Troy, N. Y. Secretary.

"Province of Executive Committee," Says Hill

Sir—I think it would be a great mistake to have the affairs of the association discussed and administered through the technical press, and however well intentioned your effort may be, I believe that if such a policy were pursued it would result in ultimate detriment to the association. It seems to me that this work is clearly within the province of the Executive Committee, that it is its function to circularize the association to ascertain the feeling of the membership and to outline its policies, and I think that the washing of linen should be at least limited to the convention and should not occur in the technical press.

I fully realize that this is a critical period in the history of the association and that all thinking members have got to put their shoulders to the wheel and work. So that there may be no misunderstanding about my position in the matter, I wish to say that I have written to the Executive Committee this morning, expressing similar views on the question. NICHOLAS S. HILL, JR.,
New York City. Past President.

[Mr. Hill has since informed us that six or seven members of the Executive Committee have approved his stand.—Editor.]

Cuddeback Against "Further Public Discussion"

Sir—Owing to the unfortunate view which some of the members of the association took of the outcome of the recent election, and the hard feeling which seems to have been created, I feel that further public discussion in the technical press would not be for the future benefit of the association.

I appreciate fully that the *Engineering News-Record's* only object in having such discussion for the members of the association, is one of benefiting the association.

I am deeply interested in the welfare and future of the American Water-Works Association, and I feel that the Executive Committee of that association can best work out its future if there is no further general discussion in the technical press. A. W. CUDDEBACK.
Paterson, N. J.

"Positive and Fearless Stand"—Chester

Sir—The reading of your articles created in me a feeling of gratefulness toward your journal for its positive and fearless stand. It is unfortunate there is no code of ethics, written or unwritten, in our association by means of which unprofessional conduct of some of the officers

and members might lay them liable to further investigation and if guilty, as accused, dropped from the rolls of our membership.

Not until the majority of our membership accept the principle that our association is not primarily for the advertisement of goods, chattels or personality, but was constituted and should be maintained for the betterment of water-works practice, will incidents like those that have just occurred cease to disrupt our organization.

J. N. CHESTER.

Pittsburgh, Penn. Chester & Fleming, Engineers.

"Favor Further Consolidation of Technical Societies"

Sir—I have no sympathy with the politics of the association of recent times and the manipulation in favor of individuals and rings.

I am in favor of well-developed, reasonably sociable, district societies, to consider abundant short papers, but only those to reach publication that should be on permanent record or possess truly educational value.

I am in favor of further consolidation of technical societies, a lessening of conventions and annual meetings; more work, less play and dependence for existence on active memberships, rather than on supply houses.

The great engineering societies might well cover the whole field to advantage through the local division method and special sections, but probably the water-works associations have grown to such a size that pride would prevent dismemberment, yet more and more their members are enrolled in the other lists.

LOUIS L. TRIBUS.

New York City. Tribus & Massa, Engineers.

"Put Needs of Superintendents First"—Too Much "Machine" at Richmond

Sir—First and foremost, the association should consider the needs of the superintendents and officers of water-works. The place to read technical papers in the field of water-works engineering is at a meeting of engineers; and when engineers read papers before the association, they should always endeavor to interest the superintendents. They may well interpret to their fellow members in the association the conclusions of engineering investigations, and in return the superintendents ought to give the engineers the benefit of their practical experience by writing and discussing papers. The engineers advise, the maufacturers sell, but the superintendents use, or try to use, and their experience is of final value.

In spite of the excellent technical program, the fine exhibits and the enjoyable entertainment at Richmond, it was quite evident to those attending the convention that the machinery of the association ought to run more smoothly. There was too much "machine" anyway. If smoothness can be gained by changes in the constitution which will make the government of the association more democratic or more truly representative, it is hoped that the committee intrusted with this matter will report the necessary changes and that the association will adopt its recommendations. If changes in offices are made, the Executive Committee or its equivalent should remain small in number for the sake of efficiency. It might be well to enlarge the Nominating Committee to make it represent more localities, but the present Nominating Committee is as representative of the association as is that of many technical societies.

In this connection, the writer recalls an editorial in the *Engineering News* regarding "Municipal vs. Private Ownership," in which it was stated that the proper management of water-works depended upon men rather than methods; the writer believes that competent men filled with a spirit of service and a desire to coöperate can do good work under the present constitution.

It is obvious that the association ought to live within its income, and therefore must be discriminating in the choice of papers for its "Journal." Many papers excellent for presentation at the meetings are wholly unsuitable for printing. Neither should other expenses be incurred in excess of income, and the requests for special contributions should never occur again; the dues should be raised instead, if necessary.

As the writer is on the Nominating Committee, it is hardly proper for him to express an opinion regarding the choice of men for officers. As a general principle, however, he believes that the principal offices of the association should be filled by superintendents more often than by practicing engineers. At present, the majority of the officers are engineers.

Regarding the work of the committees, the writer is in hearty accord with the views expressed by President Metcalf in his annual address. Furthermore, he believes that no committee ought to be appointed until there is a real need for investigation and report upon any particular subject, and, if practicable, every interest concerned should be represented on each committee. A long roster of committeemen and a dearth of reports is an unhealthy sign.

The writer has felt for some time that it was unfair for the members to depend so largely upon the Manufacturers' Association for entertainment, and he for one would be pleased to pay his share of the expense connected with the enjoyable and necessary entertainments. This is perhaps too much to expect, but is certainly more democratic in principle than the practice established by long custom.

If every member who attends the next convention will go with the idea that he will contribute something to the work of the convention and to the interest of his fellow members, and for the time will lay aside the thoughts of the benefits, direct or indirect, which such an action will unavoidably and unquestionably bring to himself, the association will prosper beyond our greatest expectations. Service secures success—for the association.

ROBERT SPURR WESTON.

Boston, Mass. Consulting Engineer.

Hawley Urges "Strong, Live, Well-Paid Executive"

Sir—I feel that there is little to be added to the excellent statement of facts in your editorial of May 17. The disgraceful exhibition of politics in the last election surely ought to bring about a reaction which should clear the decks and retire permanently all the men responsible for what was done. The members of the association should place in evidence their disapproval of such trickery by making Mr. Henderson the next president of the association.

The American Water-Works Association must now determine whether or not it is to be managed by the water-works men or by the supply men. It is some time since the New England Water-Works Association settled this question, and the American Water-Works Association should have done so years ago.

The last paragraph of your editorial refers to another matter of vital importance. The association should have the services of a strong, live, well-paid executive officer devoting his entire attention to its affairs. The work of such a man ought to increase the revenues of the association sufficiently to more than take care of the additional cost.

W. C. HAWLEY,
Chief Engineer and General Superintendent,
Pennsylvania Water Co.

Wilkinsburg, Penn.

"Method of Handling Nominations" Should Be Changed—Brower

Sir—I am in favor of the association being of a technical nature with every opportunity given the practical man to relate or to give results of his years of experience, as I believe this is of great importance both to the purely technical man and to the man who combines both his technical knowledge and practical experience. There is no reason why the technical side should not be of very great benefit to the purely practical man.

There is no doubt after the results of our recent election that there should be some change made in the method of handling nominations for officers.

I. C. BROWER,
Evanston, Ill. Commissioner of Public Works.

"Should Abolish Politics"

Sir—Your remarks meet with the approval of one who has been connected with water-works matters since 1851 and regretted being unable to go to Richmond. The association should abolish politics, combine the technical with the practical and aim to interest every member.

WILLIAM PERRY,
Consulting and Hydraulic Engineer.

Montreal.

No Name on Ballot Unless Nominee Has Pledged To Serve If Elected—Trautwine

Sir—You ask for my "ideas as to what changes, if any, are needed, to make the association more useful to its members and to the public; more efficient and thoroughly democratic."

I suppose that there is but one change which can effect this—we must be born again. A stream cannot rise above its source. Either the personnel of its membership must change, or the standards of the present membership must rise, if the association is to be brought into line with (say) the New England Water-Works Association.

True, a given membership may accomplish more under a good than under an imperfect constitution; and conversely, a better constitution will attract better members: but then the constitution itself is only an expression of the membership, an index to its character.

My early impressions of the American Water-Works Association (dating back some 20 years) were to the effect that the association complexion was then determined by a group of choice spirits whose devotion to water was not so bigoted as to exclude a saving appreciation of the merits of other fluids. That complexion then seemed, to me, to be partly technical, largely commercial and supremely convivial.

And the association's working machinery (in so far as I had occasion to notice it) seemed to be just such as should have been expected from the membership of that day. There was (for instance) a plentiful lack of such safeguards as might well have been set up against hasty and ill-considered action upon important questions; such questions being put to *viva voce* vote before a small group of members, most of whom had no idea as to the nature of the question and were impatient to escape from the non-hilarious atmosphere of the meeting.

With you, I believe that the situation has vastly improved, since then, in both of these particulars; and yet I have long felt that there still remains too much of laxity in our business machinery.

This impression was mightily confirmed when, to my surprise, in March, 1917, last, I found myself regularly nominated for the treasurership, and my name so printed on the regular announcement—although I had no intimation that it had occurred to anyone to consider me eligible for that position. To me, personally, this made not the slightest difference. If I had believed that I could serve acceptably, I should gladly have accepted the nomination in spite of the informality; but the constitution or by-laws should require that the submission of a ticket be accompanied by a statement, over the signatures of the nominators, that the candidates named have pledged themselves to serve, if elected.

The mother of the bad boy is naturally desirous that he should associate intimately with the good boy next door; and the carryings-on, mentioned by you as having taken place at the recent Richmond convention, indicate the desirability (from the American Association's viewpoint) of some sort of affiliation with the New England Water-Works Association.

JOHN C. TRAUTWINE, JR.,
Philadelphia, Penn. Civil Engineer.

Prohibit Making One Man Candidate for Two Offices

Sir—I would advise no hasty action, as it would simply lead to trouble after every election. However, it seems clear to me that it should be made impossible for one person, at one time, to be a candidate for more than one elective office.

G. C. HABERMEYER,
Urbana, Ill. Engineer, State Water Survey

Make Convention Programs More Closely Fit Smaller Cities

Sir—I am wholly in sympathy with your attitude relative to the "practical" and the "theoretical" man. A machinist at the start, I left the practical (?), taking both scientific college courses and the technical mechanical-engineering course. I have since drifted back to the practical—or to water-works superintendence.

Can you not coin a word to cover the happy blending of the practical and the theoretical? For this is what the really efficient man in any sphere is.

I see absolutely no occasion or time for controversy between the water-works consulting and designing engineer, and the water-works superintendent or plant engi-

ment. As a natural optimist, I believe that the American Water-Works Association will eventually become a harmonious mixture of these two tendencies—or better yet, an association of men having these tendencies harmoniously united.

I suggest that, while the large cities are important, the smaller cities greatly outnumber the large ones. The programs should be arranged to more closely fit the conditions of the cities of populations from 5000 up. In attempting to apply the accounting system recommended by the association I am met here with the criticism that it is for the large cities. While this criticism is untrue, in some degree the criticism fits other features of the association, which appears to me not to give due consideration of the problems of the smaller and medium-sized plants. GEORGE A. MAIN.

Daytona, Fla.

Failure "To Follow Ethics of the Profession"

Sir—The outstanding fact responsible for the unfortunate conditions noted in your issue of May 17 would seem to me to be a failure on the part of someone, or several, to follow the ethics of the profession. There is no business or profession that can long succeed if the recognized ethics of such business or profession are violated. Temporary success, or elevation to office, is but poor recompense to any man who values his future reputation if such preferment comes to him through the employment of trickery or by the use of methods not approved or permitted by our ethical standards.

It is possible that the experience of the association at the recent meeting at Richmond will actually be a benefit to the association for the reason that the entire membership of the association can now understand that it is possible for a few designing people to employ political methods for personal aggrandizement instead of awaiting honors which real merit might bestow.

It is certainly true that such methods as you have described as temporarily controlling the situation at Richmond, if persistently repeated, would wreck the association, but it seems equally true that the commonsense and intelligence of the great body of the membership would not permit a repetition of such methods in the future. LAFAYETTE HIGGINS,

Civil and Sanitary Engineer,

Des Moines, Iowa. Iowa State Board of Health.

"Permanent Headquarters Near Center of Population"

Sir—Although I am a "technical" man, I have hitherto held the belief that the work of the association could be most efficient by making it a brotherhood of the nontechnical operators. In taking this view of the matter, I think I have been influenced most by observing the existing political conditions which govern so many municipally owned water plants.

It is all too frequent that we see the superintendent of such a plant changed with every shift in the political wind, and these are the men who really need the help of a brotherhood such as the association could be. I have expressed this opinion so often that I fear that I will appear insincere in the growing conviction that the work of the association is primarily technical, and that it should and must take its place among the major technical societies of the world. How to bring this about, and still take care of the nontechnical men who will be water-works superintendents so long as our present political condition continues, I cannot tell, but it is possible that the present task of the association lies in everlastingly hammering home the fact that the work of the water-works superintendent is a technical work until the employers see it themselves, and believe it. At that time, the association will take its place among the technical societies.

As to what changes are necessary other than this, without a doubt the rank sectionalism exhibited at the last convention must be abolished. Dirty politics must have no chance to make the association a laughing stock again. I suppose we "Westerners" will be accused of sectionalism if we ever refer to the recent election, but we honestly want to work for the good of the association in any way we can, and the recent spectacle was not one in which we take any pride.

I believe that permanent headquarters in some city near the center of our population would do much toward getting out a fuller attendance at the conventions, and would cut out some of the petty jealousies which occasionally crop out; and finally I believe that the association is slowly but surely advancing and eventually will take its rightful place among the most helpful technical societies of the world. It must not grow away from us, but we must grow with it. W. A. JUDD.

Mason City, Iowa. Superintendent Water-Depart.

"Management Must Become More Democratic"

Sir—The trouble that broke out at Richmond has been brewing for many meetings and the revolt was seriously discussed at the time of the meeting in Philadelphia. There is an undercurrent of feeling in the association that will have to be reckoned with in the future.

Most of the men who attend these meetings are men who are actively engaged in the management of water-works throughout the country and they feel, whether rightly or not, that they have been pushed aside by the technical men who are there for the express purpose of advertising their business as consulting engineers for water-works.

Many of the papers which are read before the association meetings are very valuable and scientific papers, but are beyond the reach or grasp of the men who are actively carrying on the work of management of the different properties throughout the country. Such papers properly belong in the "Transactions" of the American Society of Civil Engineers.

I have heard many members say at these meetings that they did not like to get up and discuss simple things that come up in the operation of their plants, as they felt that they were only subjecting themselves to criticism from technical men in the convention.

I thoroughly realize that the bulk of the work is being carried on by a few men, and that unless something is done to secure the coöperation of all the superintendents and managers, this association will develop into strictly a technical association. Whether or not it will be able to stand alone as such an association I am unable to say.

I fully realize that the business of managing water-works is no longer a business of rule of thumb, but the work must be conducted on a scientific basis and under the advice of the best engineers of the country.

If the present membership is to be retained, and be increased to what it should be, then the management of this organization must become more democratic in the future than it has in the past.

I have enjoyed the meetings which I have attended. I have obtained valuable information from the "Proceedings," and am not seeking any office or personal advertisement, but this rock has been seen ahead for many years, and the technical men of the society are well aware that this trouble has been brewing, and I do not believe they have taken any precautions to avoid the shipwreck which is imminent.

I stand ready to coöperate in any way for the upbuilding of this association, as I believe it should not go to pieces, and every effort should be made to bring all the interests together on a common basis, so that all may profit by the continued work of all the members of the association.

CHESTER R. MCFARLAND,
Secretary and General Manager,
Tampa, Fla. Tampa Water-Works Co.

Broaden—Amalgamate—Sectionalize by Subjects and Geographically

Sir—The American Water-Works Association, in my opinion, should be purely a technical society. Water-works, to the general engineering profession, as well as to the layman, signifies engineering construction and maintenance. I suggest:

1. That the work of the association be broadened in both water and sewerage engineering.

2. That the membership be divided into four sections: (a) Hydraulic engineers; (b) sanitary engineers; (c) superintendents; (d) manufacturers, and that special committees from each group decide questions and pass on articles pertaining to the respective sections.

3. That the name of the association be changed to "American Association (or Society) of Hydraulic and Sanitary Engineers."

4. That the American Water-Works Association and the New England Water-Works Association merge into one society.

5. That the United States be divided into six sections with second vice presidents of the association as chairmen of these sections; they in turn reporting to a first vice president, each second vice president to have a secretary who reports to the second vice president, and also to a grand secretary.

MODEST ENGINEER MEMBER.

"Why Not Merge" the Two Associations?

Sir—Having been so situated for several years that I could watch at close range some of the most putrid politics that ever blasted an American municipality, the writer begins, perhaps naturally, at what seems to have been at the bottom of the trouble at the Richmond meeting, and immediately prior thereto.

However much we may laud republican institutions and correspondingly condemn autocracies, the former indubitably has, always has had, and will have for centuries to come, the attendant curse of politics. There is but one antidote and that is education; not the narrowing, well-lubricated, finely grooved education of the schools, but the broader education of human experience which shall eliminate self and lead, through altruism, to the ideal republic. In no other way will the slimy trail of the politician, extending all the way from the church to the chair of the national executive, ever be eradicated. So far from decreasing this evil in a water-works organization, of whatever character, it is an unfortunate fact that a technical education may render its possessor more dangerous on account of the prestige which a trained mind is apt to give him in the community.

Regarding the old-time friction in association matters between the untechnical superintendent and the engineer, it seems to me little needs to be said. The writer, himself an engineer of many years' experience, wishes to testify that the most helpful incidents of attendance at many water-works meetings have been, not the papers and the subsequent discussion thereof, but instead the quiet little chats with members who rarely, if ever, took part in discussion on the floor, and many of whom were these same nontechnical superintendents; and, incidentally, he has heard many other water-works men express the same sentiment.

That with the march of progress the nontechnical man should give way to the technical one in water-works management is natural and inevitable. In fact, it has already been accomplished to such an extent that, it seems to me, there remains very little friction on that score.

Without going further into the matter, I am going to make a sweeping suggestion which, if put in operation, I think would cure most of the evils which now beset the American Water-Works Association. For a long time I have been unable to see the necessity in this country of two such organizations as the American Water-Works Association and the New England Water-Works Association, covering as they do practically the same intellectual ground and composed largely of the same membership. Why not merge the two, with a view to gaining the virility and wise organization plans of the latter with the membership, and possibly the name, of the former? Then with sectional suborganizations to accommodate the members territorially and insure frequent meetings, and one grand convention annually, it seems to me that a powerful and exceedingly valuable organization might be built up.

ERMON M. PECK,
Hartford, Conn. Civil Engineer.

"Some One on the Job All the Time"

Sir—It seems to be impossible to build a national society to fit more than one class of members unless the association is so divided up into subsidiary organizations that they may be practically independent of each other except as to the business matters connected with fees and dues, arrangements for meetings, publication of proceedings and such matters of mere business. The struggle of the different kinds of members for control always makes trouble, especially when the management is either too strict or too lax.

The best results seem to be attained when the national organization is more strictly technical in its requirements of membership and then has branches or subsidiary local organizations in which the requirements of membership, locally, are not so strict. Then the members who might be troublesome in the politics of the national society are either able to work off their energy in this line in the local organization or they are too few in numbers to be able to make any trouble anywhere.

Such an organization needs someone who will be on the job all the time and who can have time and money enough at his disposal to keep the national organization up to its best work and help out on the local organizations whenever opportunity or need offers. I have been secretary or president of some one or more organizations, either local or national, all the time since I got established in my profession, and I confess this form of organization appeals to me and I feel that I would enjoy the work of looking after it if anyone should ask me. But there must be no politics or self-seeking in such an office, and it is not likely that my feeling regarding the matter will become known to anyone.

The constitution should certainly be broad enough so that the membership can express its desires in the selection of officers and of policies to be pursued. It is true that an organization is nearly always controlled more or less by a few men. But the constitution must be such that these men can control only because they have good and progressive projects to offer and never because they can control the machinery of elections. No self-respecting man who is competent for the job can afford to take hold of an organization where he must be looking after his political fences all the time instead of making good by the work he does.

If the American Water-Works Association could make itself as single-minded as the New England Water-Works Association, it would soon demonstrate its value and there would be no more question about combining the two associations into a dual coördinate body if not into a single association. PRACTICAL EXPERIENCE.

Agrees with Most of Editorial—Is Opposed to Dirty Politics

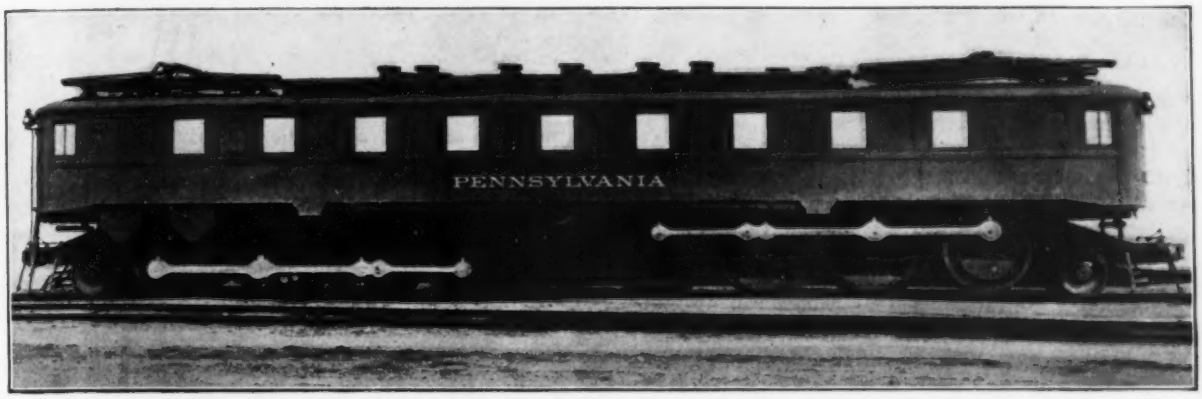
Sir—I agree with most of your editorial and do not now care to make any comment on the actions of the recent convention or any suggestions as to the future of the association. Of course, you understand that I am heartily in favor of doing my share toward the upbuilding of the association; and you may also know from my action on the floor of the convention, the last night, that I am opposed to any such dirty politics as was carried on by a few members in the recent campaign for officers. You may use this as you see fit. H. B. MORGAN,

Peoria, Ill. General Manager, Peoria Water Co.

Pennsylvania Builds Novel Heavy Electric Locomotive

Engine Designed for Future Freight Service Over Allegheny Mountains Will Be Tried Out Elsewhere

A 240-TON electric locomotive, with a tractive effort at maximum speed of 87,200 lb., has been built by the Pennsylvania R.R. for trial service on the company's electrified lines at Philadelphia, and possibly on the Norfolk & Western mountain electrification, in anticipation of the electrification of the Allegheny Mountain section of the Pennsylvania between Altoona and Johnstown, Penn. The locomotive is designed to handle 3350 tons on a 1% grade. Two of the engines, one pushing and one pulling, will be able to haul a 3900-ton train at 20.6 miles per hour up the 12-mile 2% grade from Altoona to Gallitzin, or a 6300-ton train up the 25-mile 1% grade from Johnstown to Gallitzin.



PENNSYLVANIA BUILDS HEAVY ELECTRIC LOCOMOTIVE FOR MOUNTAIN SERVICE

A novel feature of the new locomotive is the placing of the motors ahead of the drivers, adjacent to the pony trucks. There are four motors, each with a rating of 1200 hp. Two motors are mounted on each unit. The units are articulated, but there is only one car body for the two units. As in the Norfolk & Western electrification, energy is derived from an 11,000-volt, single-phase, 25-cycle overhead system.

Only one normal operating speed, 20.6 miles per hour, is provided. This speed is the maximum that is considered safe for the heavy trains that the locomotives will be required to handle on the grades of the Altoona division. A speed of 10.5 miles per hour can be obtained by connecting the motors in "cascade."

The locomotive is 76 ft. 6¼ in. long over all. It was built at the company's Altoona shops, the Westinghouse Electric and Manufacturing Co. furnishing the electrical equipment.

Municipalities May Lease Water-Works

Any city, borough or town in Pennsylvania may lease and operate privately owned water-works for a term of years, under recent state legislation. Property "so acquired," to quote from the act, "shall be operated in the same manner as if" it "had been acquired by purchase or condemnation proceedings."

Measuring, Locating and Stopping Leaks on Sewer Contract

Pipe Bared and Aniline Dye Used To Locate Leaky Joints—Cement-Mortar Collars Applied

By ROBERT B. RAY
City Engineer, Bakersfield, Calif.

WHEN the sewer system built for Bakersfield, Calif., in 1913-14 was completed, one line, comprising about 6600 ft. of 10-, 12- and 14-in. vitrified pipe, was found to be leaking badly. This line is located in low, flat ground, and the sewer, throughout most of its length, is covered by groundwater to a depth varying with the seasons of the year. The exact amount of leakage into the line was readily determined, owing to the fact that this sewer empties into a concrete-lined reservoir, from which the sewage is pumped to a gravity outfall sewer.

Series of Leakage Measurements Made

From measurements extending over a period of 24 hours in February, 1914, it was found that the leakage amounted to 70,500 gal. in 24 hours. At the time of this test, the groundwater was probably slightly above the mean stage. On Oct. 13, 1914, with the groundwater near its lowest level, the leakage was 39,075 gal. in 24 hours. From observations on the level of the groundwater at various points along the line of the sewer it was determined that infiltration was taking place at an average rate of 6.83 gal. per lin.ft. of submerged joint.

On May 11 and 12, 1915, a similar test was made. It was estimated that the top of the pipe was covered to an average depth of 3 in. throughout its whole length. The flow at this time amounted to over 121,000 gal. in 24 hours, giving a leakage of 15 gal. per lin.ft. of joint in 24 hours. This test was made by C. B. Greeley, then city engineer of Bakersfield; C. P. Jensen, then city engineer of Fresno; and A. K. Warren, an engineer of the Kern County Land Co., the engineer by whom the sewer system had been designed. Their report to the council concerning this test says: "This [rate of infiltration] we consider to be excessive, not in any manner to be construed as complying with the specifications. . . ." The specifications provided that "the trench between manholes shall be filled with water until the pipe is covered with 4 in. of water. Any infiltration shall be permanently stopped and such sewer shall be relaid, if necessary for that purpose."

After nearly a year's delay, during which the contractor declined to repair the defective sewer, the council instructed the city manager, Wallace M. Morgan, to proceed with the work, the expenses of the operations to be paid out of the balance retained from the contract price of the sewer system. The work of repair, or virtual reconstruction, was done under the direction of the writer, who was appointed city engineer upon the resignation of Mr. Greeley.

Leaky Joints Found by Use of Aniline Dye

The mode of operation was as follows: First, the trench was opened and the pipe uncovered down to about its middle. The soil was then scooped out entirely around the pipe at each joint, leaving a series of oval-shaped depressions beneath the pipe. In the majority of instances the groundwater was at such a height that the depressions beneath the joints were only partly filled with water. In other cases the groundwater was high enough to render pumping necessary, certain portions of the line being entirely covered by water. As the soil at the depth of the pipe was almost pure sand, the flow of water into the trench was very great, and sheeting had to be done with considerable care. For the most part, ordinary 2-in. pine lumber was used.

After the joints for a distance of one block were exposed as described (or for a less distance when pumping was required), the pipe was tightly plugged in the manhole at the lower end of the block. Water was then introduced into the pipe above and allowed to flow down until the block of uncovered pipe was entirely filled. During the filling of the pipe a man was stationed in the manhole at the upper end of the block. As the stream flowed past him, he slowly sprinkled red aniline dye into the water, which was thus colored a bright red. This water, trickling into the little pools below the joints, revealed all the leaks, even the very small ones. The defective joints were marked as found, after which the pipe was emptied and the trench allowed to drain if, as was frequently the case, it became partly filled by the leakage from the pipe.

Method and Cost of Repairs

The defective joints were then carefully cleaned, and a thick collar of rich cement mortar was applied directly over the old joint. A strip of muslin about 9 in. wide was tied snugly over the cement collar to prevent its falling away from the pipe or being washed out of the joint by groundwater. It was found that fresh joints protected by this means were not injured by exposure to water where there was no current. Where water came into the trench in a quantity sufficient to make an appreciable current, no chances were taken, and it was kept down by pumping.

After the cement mortar had had time to set hard, the pipe was again filled with water, colored as before, and any leaks remaining were repaired and the trench backfilled. After the repair of the line was completed, several measurements of the infiltration were taken. A comparison of the infiltration before and after the repair may be interesting:

Date	Total Leakage, Gal.	Estimated Rate per Lin.Ft. of Joint Submerged, per 24 Hr.
Before Repairing:		
Oct. 13, 1914	39,075	9.6
May 12, 1915	121,000	15.0
After Repairing:		
Dec. 29, 1915 to Jan. 10, 1916, 12 days	1,200 per day	0.3
Feb. 10, 1916	12,000	1.5

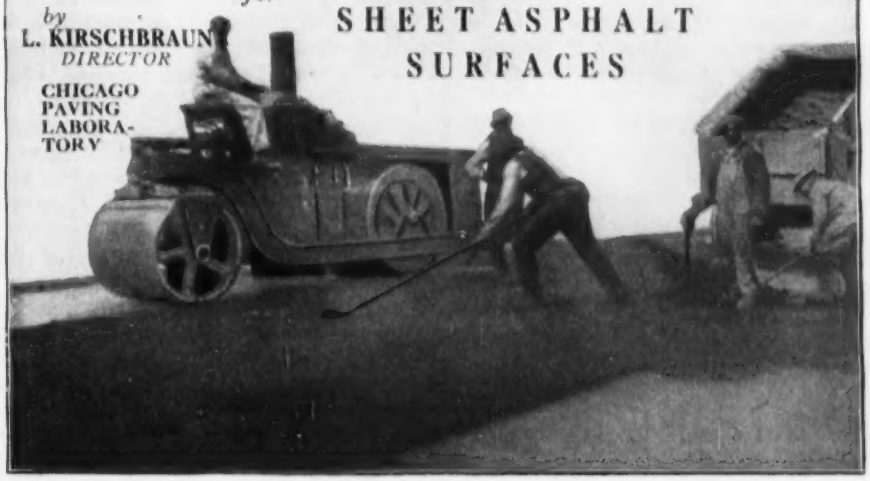
The cost of repairing the sewer was $3311, of which $972 was for material and $2339 was for labor. Work was begun on Aug. 16 and completed on Oct. 30, 1915.

County Guarantees Its Cement Estimate

In designing the concrete roads of Snohomish County, Washington, an estimate of the amount of cement was made and incorporated in the specifications. Any additional cement used was paid for by the county, and any amount less than the estimate was deducted from the price paid the contractor. The actual amount of cement used has been remarkably close to the estimate.

BITUMINOUS FOUNDATIONS *for* SHEET ASPHALT SURFACES

by
L. KIRSCHBRAUN
DIRECTOR
CHICAGO PAVING LABORATORY



The views of an engineer well known in the paving field are here presented. The facts and reasoning are bound to focus attention on the basic question of the purposes to be served by a pavement foundation. It is, of course, a matter wherein opinions are bound to differ. The question of the relative weights that should be given to rigidity, unity of action between base and surface, waterproofing quality, cost and ease of repair is opened to discussion by the definite presentation of Mr. Kirschbraun.—Editor.

CONDITIONS resulting from heavy motor-truck traffic are accenting the necessity of many changes in established construction methods, even so far as to bring under question the sufficiency of the usual type of foundation. Recent articles in the technical press have directed attention toward the possibility of employing other materials besides portland-cement concrete and have shown the effect of modern loads in wrecking foundations under asphalt surfaces. As a particular instance: During the past summer in Chicago, two weeks of unusual motor-truck traffic upon a perfectly good asphalt pavement smashed the 5-in. concrete foundation, with the attendant and inevitable injury to the surface.

In addition to the above consideration, the question of economy must be considered. The last two years have seen an increase in the price of portland cement which is adding to the cost of usual pavement construction a sum sufficient to give considerable concern; and while public officials may be justified in paying the increased price, nevertheless it might be well at this stage to inquire whether a portland-cement concrete foundation is the best for sheet-asphalt surfaces, or whether there may not be other forms better suited to this purpose.

For many years the writer has closely observed the behavior of portland-cement concrete foundations and has come to the conclusion that in the use of this type for bituminous surfaces there are disadvantages which justify the consideration of some other form of base. The use of a bituminous-concrete foundation for a bituminous surface is not new—in fact, at one time it was very widely employed. Sections laid 20 to 35 years ago are still in existence in Washington (D. C.), Chicago, Omaha, Pittsburgh, Buffalo, Denver and, no doubt elsewhere, and are giving satisfaction. There being, therefore, nothing particularly unique in this type, it is the opinion of the writer that study, particularly in the light of today's conditions, will disclose that it possesses many virtues which are lacking in the less yielding portland-cement concrete.

Experience has shown that asphalt wearing surfaces themselves can easily withstand the heavy traffic of the larger cities. Chemical and physical methods of mixture control have been developed to a degree that insures the preparation of mixtures capable of successfully withstanding a wide range of climatic and traffic conditions, and it only remains to utilize their virtues in such a way as to obtain their maximum service.

Exceedingly few asphalt surfaces endure for their potential life. In fact, the life of a standard asphalt pavement is seldom limited by the wearing away of its material or by defects inherent in the surface. We have been prone to consider that the only function of a satisfactory foundation for bituminous pavements is to furnish a support for the wearing surface. While it is true that support is essential, it is also true that there are many other requirements which should be met and that, aside from the ability rigidly to support loads, portland-cement concrete fails in some ways to supply the conditions which favor the maximum life of an asphalt surface. Many weaknesses and defects commonly attributed to asphalt surfaces are the result, direct or indirect, of shortcomings of the portland-cement concrete foundation, which, hidden by wearing surfaces, has not received the same amount of attention and study as is ordinarily given to concrete exposed to observation and wear as a road surface.

If a properly prepared asphalt wearing surface can be made to hold its shape and is protected from the action of water from below, two of the most common causes of failure will be avoided. If it were possible to apply an asphalt wearing surface to the supporting structure in such a way that the action of these agents could be prevented, the most potent forces leading to its destruction would be removed and its average service would be greatly increased.

Besides the friction between surfaces in contact, there is no bond between the comparatively thin asphalt surface and the concrete foundation. Roughened contact surfaces naturally increase this friction, but still fail to provide a natural bond such as exists between binder and top. A portion of the effect of traffic shock or thrust produces a horizontal component, and the absence of a positive bond between veneer and foundation becomes, therefore, a source of weakness.

The displacement of a bituminous surface most generally takes place first at the plane of its contact with the foundation and is due to a forward movement upon the base accompanied by an internal movement of the mixture itself. Of course, the internal stability of the mixture itself and the amount of the friction will assist in preventing movement; yet if foundation and surface were, in effect, integral, it is apparent that a most important condition favorable to displacement would no longer exist.

THIS CRACK—CONTINUOUS THROUGH CURB AND GUTTER—MUST HAVE ORIGINATED IN THE FOUNDATION

Furthermore, it is apparent that a substantial thickness of bituminous concrete will not be so easily affected by temperature changes and will remain cooler in summer and, as a result, more stable under such conditions than will a thin surface.

Also, it may be well at this point to emphasize particularly the effect of mass and thickness in stabilizing bituminous mixtures. The contact plane between the surface mixture and its nonbituminous support is, as stated before, a seat of weakness. Whether the support be a thin concrete base or the subsoil directly, it becomes important to minimize at this contact plane the intensity of all forces, particularly those tending to lateral movement, which may reach the foundation from the surface. The effect of the thickness of a shock-absorbing medium in distributing and minimizing these forces should become apparent without further discussion.

Moisture acting on the under side of a bituminous pavement destroys the bond between mineral aggregate and bitumen, and the wearing surface is more easily displaced. Both waterbound macadam and portland-cement concrete absorb moisture from the earth through capillary action. Since a bituminous covering prevents evaporation, the surface of such a foundation is usually moist, providing a condition favorable to disintegration. In spite of the fact that much has been said about waterproofing wearing surfaces, nothing has been accomplished to eliminate this as a source of trouble attendant upon the use of portland-cement concrete or waterbound macadam foundations. A bituminous-concrete foundation, on the other hand, is a natural and complete waterproofing.

Cracking of bituminous surfaces has generally been attributed to some defect of the mixture or materials. Here again the bituminous surface has suffered from the behavior of portland-cement concrete, though this statement does not mean that defects of mixture composition may not be entirely responsible for a certain percentage of cracks; but observation proves that the majority of cracks observed in well-prepared surfaces are duplicates of cracks in the portland-cement foundation.

A recent examination of a well-distributed yardage less than one year old is significant. The surface was removed from eight cracks, most of which did not show the usual crack at the curb; and each and every one of these was found to duplicate a defect in the concrete foundation.

Barring frost action, pavements laid over broken stone, old brick or macadam base show very little tendency to develop cracks. This fact is quite generally recognized. Some striking demonstrations may be observed on surfaces of identical composition constructed upon portland-cement concrete and other types of foundations at Joliet, Evanston, Oak Park, Chicago, Lake Forest (Ill.), Saginaw (Mich.) and elsewhere. In fact, newly constructed asphalt surfaces on portland-cement concrete bases have been observed to crack during the hottest days of summer. Since neither broken stone nor macadam bases induce these cracks—all the expansion and contraction being taken up between the individual stones—a bituminous-concrete base will surely act as well, for each stone and particle of aggregate is covered with elastic bitumen.

The relative rigidity of portland-cement concrete gives it a low shock-absorbing ability—and pavements not only must support dead-load, but must resist the smashing and impact of traffic. When portland-cement concrete is used as a foundation for bituminous top, this rigidity causes it to act as an anvil, necessitating the absorption of shocks largely by the wearing surface—concentrating the full effect of smashing blows in this comparatively thin layer. A bituminous-concrete foundation, on the other hand, being integral with and of the same plastic character as the wearing surface—having great shock-absorbing capacity, in short—will relieve the wearing surface of much of this sort of strain.

The earth or subgrade is the ultimate support of a pavement. Since foundations are merely means for distributing the load, portland-cement concrete has, in this respect, the advantage over bituminous concrete. On account of its rigidity or structural strength, the former will distribute the load to the earth with less regard to minor unevenness of density of the subgrade. Furthermore, concrete usually bridges over minor depressions and

maintains a surface, the portion having solid contact with the subgrade acting as an abutment for the unsupported area. Should it go down, it will seek its bearing in large slabs or sections, maintaining a fairly even contour.

Bituminous concrete, on the other hand, yields under steady load and seeks, in a much more sensitive manner, to complete its contact with the subgrade. An unevenly compacted subgrade would eventually show in the wearing surface. The use of a bituminous-concrete foundation must, therefore, be attended by careful preparation of the subgrade. Uniform compactness must be secured, and in all cases there must be provision for thorough drainage. In fact, where the subsoil is not of such character as to maintain itself firmly, it is desirable to specify a course of broken rock, cinders or a thin course of portland-cement concrete under the bituminous foundation proper.

EVERY DETAIL OF THE CRACK IN THE SURFACE CAN BE TRACED TO THE CRACK IN THE FOUNDATION

Besides the fact that there are certain practical considerations of construction which favor the use of a bituminous-concrete foundation whenever conditions permit, so far as cost is concerned a bituminous-concrete foundation is more economical under present price levels. The 5-in. bituminous base requires from 22 to 25 lb. of asphaltic cement per square yard, which would cost about 20 to 25c. A square yard of 1:3:6 portland-cement concrete of the same thickness requires about 53 lb. of cement. To be on an even footing as to the cost of the cementing material, portland cement must be purchased at a price not exceeding $1.80 per barrel.

Stone and sand for either construction will cost the same, and the expense of hauling bituminous mixture from the plant to the street will be ordinarily counterbalanced by the expense of hauling from the cars to the street the individual elements going into the portland-cement concrete. That the labor of mixing and placing bituminous concrete will be less than for portland-cement concrete will be apparent when one considers the facilities at the asphalt plant for mechanically handling the constituents in large quantities. The fuel cost of heating the aggregate for bituminous concrete must, however, be considered.

A detail which substantially reduces the cost of construction on a bituminous foundation is the fact that it will be unnecessary to employ a binder course, the foundation itself acting in that capacity. For a binder course of 1½ in. this saving amounts to about 25c. per sq.yd. and in addition permits a saving in the cost of excavation or grading. In many cases, however, this saving will be counterbalanced by the cost of providing drainage or the necessity of placing broken stone or cinders upon the subgrade.

To the paving contractor it will certainly be an advantage to dispense with the extra equipment for mixing portland-cement concrete and to use instead the same equipment that must be brought to the job for the surface. In addition, in times of labor scarcity it is a decided advantage to do away with the extra organization required for the portland-cement concrete, inasmuch as bituminous concrete, both in preparation and laying, will be handled by the same men who handle the surface. It will be possible also to finish the pavement construction immediately following the grading, as bituminous concrete will require no long period of time to set, but can be "topped" almost at once. As this affects the efficiency of the organization and the speed of handling work, it will amount to no small item to the paving contractor. This reduction in cost will, of course, come back to the property owner.

An objection that may be urged against the use of a bituminous-concrete base is the seeming difficulty of making repairs to the surface without at the same time removing the foundation. At one time this really was a serious objection, but the surface heater makes it possible not only to avoid this difficulty, but to effect substantial economies in maintenance. Restoration of cuts and trenches will cause no difficulty, if carried out by the same methods now employed in maintaining bituminous pavements over a macadam base. A portland-cement concrete slab, with a sufficient bearing on either side, provides a satisfactory solution of this difficulty.

Oil Must Be Kept Out of Kansas Water

So much trouble has been caused in parts of Kansas by discharges from oil and gas wells and well-drilling operations that the Kansas legislature recently passed a bill prohibiting any such discharge that will render "deleterious for use for domestic purposes" any city water-supply. Violators of the statute are subject to penalties of from $25 to $100 for each separate day of violation, but prosecution must begin within 90 days. The need for such legislation is illustrated by an analysis of a sample of the water from Douglas, Kan., taken from the Walnut River: Total solids, 2736; calcium, 271.4; sodium and potassium, 492.3; chlorine, 874; sulphates, 508; bicarbonates, 317.5, all in parts per million.

Recommend 50,000,000-Gal. Activated-Sludge Plant

Joint Committee Representing Chicago Sanitary District and Packers Advises Expanding Preliminary Plans for Entire District and Immediate Construction and Six Months' Trial Operation of a 1,500,000-Gal. Single Unit

A 50,000,000-gal. activated-sludge plant for the mixed sewage of the stockyards district, Chicago, Ill., has been recommended by a committee representing the Sanitary District of Chicago and the various packing interests. The first cost of the plant is estimated at $3,800,000. This includes interest during construction. The annual cost is placed at $825,000, including maintenance, operation, interest and depreciation. Partly offsetting the annual charge will be the revenue from dried sludge and grease, which "should bring in a return of $150,000 to $450,000 per year, depending upon the quantity of sludge and grease reclaimed and the market price."

A single working unit, the report states, should be built and operated six months before the entire plant is designed, but the preliminary sketches already made for the whole installation should be expanded and detailed plans made for the "entire layout of screens and grit chamber or skimming basin and pumping station." The report which includes these and other recommendations is the result of some months of joint committee study by Langdon Pearse, division engineer of the Sanitary District of Chicago, and W. D. Richardson, chemical engineer, representing the packing interests.

To Produce a Stable Effluent

The report is based on the assumption that the activated-sludge process will turn Packingtown sewage into a stable effluent, suitable to discharge into the channel of the Sanitary District. A 50,000,000-gal. plant, it is estimated, would take care of the sewage from a proposed delimited district, "with sufficient flexibility to carry an overload of at least 50%."

Before activation the sewage would pass through a combined grit and grease chamber, screens and a supplementary grease chamber. The grit chamber would be in several compartments, each about 100 ft. long, and the sewage would flow through it with a velocity of about 1 ft. per sec. Both coarse and fine screens would be used. The coarse screens would be of the bar type, with a clear opening of about an inch. The fine screens would be self-cleaning, with 20 to 30 meshes per inch or else equivalent narrow slots. Data indicate that a grease-skimming area of 3000 to 4000 sq.ft. should be provided. The tanks should have low surface velocities and high bottom velocities. The amount of grease to be recovered daily from a 50,000,000-gal. plant is estimated as 1000 lb. a day, or over 3600 lb. of ether-soluble material.

Proposed 50,000,000-Gal. Plant Outlined

Interesting statements bearing on the design, total and operating costs of the proposed 50,000,000-gal. plant are here reprinted from the report, as follows:

"In accordance with results obtained at the Sanitary District testing station on the Center Ave. sewage, we have based our estimates for a plant to produce complete stability in warm weather on the following assumptions:

"1. The aëration of the screened sewage in continuous-flow tanks using 4 cu.ft. of air per gallon of sewage, with an 8-hour contact period of sewage and activated sludge.

"2. Sufficient sludge-storage capacity in the aëration tanks to care for 140% of the sewage entering the tanks. Approximately 40% of the incoming flow is returned from the settling tanks, as a mixture of sludge and sewage.

"3. The depth of the tanks has been fixed at 16.5 ft. over the plates. The air distribution proposed is through filtros plates set in unit boxes of cast iron. The ratio of the area of filtros plates to the superficial area of the tank is about 1 to 6; 1080 sq.ft. of plate area are provided for each unit of 1.5 million gallons daily, or 720 sq.ft. per million gallons daily.

"In the design suggested, 32 units are proposed, each of 1.5 million gallons' daily capacity. Each unit is 38 ft. 4 in. wide by 160 ft. long, with 16.5 ft. water depth over the plates. The tank is divided by wooden baffles into three longitudinal channels in series. A covered pipe gallery is planned between the batteries of tanks, in which the air and sewage mains can be carried. Individual air and sewage meters are included in each unit, in addition to the two large meters, which handle the entire flow of air and of sewage.

Settling Tanks

"After thorough agitation in the aëration tanks, the liquid passes to settling tanks, in which the sludge is settled out. The settling tanks proposed are of the circular Dortmund type, 30 ft. internal diameter, with a water depth of 33.5 ft. The hopper bottoms have a slope of about 60° with the horizontal. The settling period is about one hour. The Sanitary District has been operating such a tank with a period of 40 min., the normal vertical velocity being 10.4 ft. per hour.

"Where filtros plates are used for air distribution, experience shows that clean air is desirable, in order to avoid the clogging of the under surface. Oil, soot, particles of dust and other foreign material should be removed. We have, therefore, included in our estimates air washers preliminary to the compressors.

"We have based our estimates on the use of electrically-driven centrifugal compressors of the type made by the De Laval Steam Turbine Co. or the General Electric Co. These can be built to operate against any head, in ordinary service, whereas the rotary blower of the Connersville type is usually considered limited to pressures not exceeding 10 lb. per square inch.

"At the present time filtros plates offer the most satisfactory air distribution. Although the cost of maintenance may be somewhat higher than the perforated pipe grids, we believe the distribution is better and the size of air bubbles is much smaller, with consequent increase in efficiency. The basswood plates, now being tested in Milwaukee, produce a remarkably fine air bubble, insuring a considerable reduction in the use of air. The life of basswood plates is at present very uncertain, because of possible decay.

"For the operation of air compressors, pumps, sludge presses, driers, crane, electric lights and miscellaneous uses, approximately a maximum of 12,000 hp. is required with an average use in 1920 of 7500 hp. during the day runs and at night as low as 4200 hp. power.

Sludge Handling

"The activated-sludge process is peculiarly successful in producing a clear effluent of desired stability. But it also produces an enormous volume of very liquid sludge, which must be handled while comparatively fresh.

"The experience of the Sanitary District is similar to that at Cleveland, indicating that normal activated sludge will not dry as quickly or readily as Imhoff tank sludge. This appears to be an inherent difficulty in colloidal sludge. When applied to a sand bed, part of the sludge sinks, part floats, and the water separating out is between.

"From the standpoint of recovery of material of value, the only way demonstrated at present is by filter pressing and heat drying. Possibly the yeast fermentation method developed at Dublin may afford a suitable alternative for filter pressing. So far it has not been tested on activated sludge.

"A preliminary concentration appears necessary to reduce the excess water as much as possible. The experiments of the Sanitary District indicate that the sludge can be concentrated in volume on an average of 50% in two to three hours' quiescent settling. The depth of tank seems to have very slight influence on the moisture content of the concentrated sludge, depths of 10 and 20 ft. being apparently equally effective.

Filter Pressing

"In filter pressing activated sludge, the most available and complete information is derived from the working test at Milwaukee, made under the direction of T. C. Hatton, chief engineer of the Milwaukee Sewerage Commission. Unfortunately, but few experiments are available. The indications are that the sludge can be filter pressed, both by the older styles of filter press, where specially designed, and the novel platen press of the Berrigan type. As the latter press has been operated on a larger scale and proved somewhat more successful in producing a cake of uniform moisture content, we have based our estimates on Berrigan presses, with leaves in size 6 x 9 ft., taking the 24-hour capacity of a unit press at 8000 lb. of press-cake containing 75%. The press at Milwaukee actually handled 6000 lb. of cake, using eight sacks. Ten sacks can readily be used.

"The first cost of the Berrigan press is very much higher than for the old-style filter press, so that if the working of the Swift & Co. experimental plant demonstrates the efficiency of the old-style press, the estimate on filter presses can be considerably reduced.

"Our information does not indicate what the condition of the filtrate from the sludge pressing will be. It is possible that it may require treatment. This should be investigated in the unit plant and, if found necessary, arrangements made to pass the filtrate through the plant with the incoming sewage.

Drying the Sludge

"The sludge on leaving the filter press is assumed to average 75% moisture content. This can be readily dried in direct or direct-indirect heat driers of several types, to a moisture content of 10%. Sewage sludge has been successfully handled in this manner in England. Our estimates are based on direct heat driers of the Ruggles-Coles type or equal. The equipment provided includes an air-washing chamber to condense the vapors derived from the moisture driven off. The evaporation in the driers has been taken at 8-lb. of water for each pound of coal. Undoubtedly, Illinois screenings would be used. The cost of coal has been taken at $1.75 per ton, f.o.b. cars. This is low under present abnormal conditions.

"Owing to the fluctuating level of Lake Michigan, due to wind movement and seasonal changes, which in turn influences the level of the Stockyards Slip, the head available for the operation of a treatment plant may fluctuate widely. Backing-up of the intercepting sewers would surely follow. To insure reasonable velocities in the intercepting sewer and sufficient head to always operate the treatment plant, we have estimated a pumping station containing two screw-pump units, motor driven, to lift the sewage through approximately 3 to 5 ft. from the sewer. One unit has a capacity of 50 cu.ft. per sec.; the other, 100 cu.ft. per second.

Estimated Construction and Yearly Costs

"The estimates (Table I) are based on the use of reinforced concrete throughout the grit chambers, grease skimmer, screen chamber, aëration and settling tanks; on mass concrete on all foundations for buildings, machinery, etc.; on neat brick buildings, with face brick outside and common brick inside, covered with fireproof roofs, supported on steel trusses. The machinery prices are based on a first-class grade of machinery throughout. All prices are based on current prices in December, 1916, so far as they could be obtained, and consequently are higher than normal for all machinery, steelwork, cast-iron pipe and other steel or cast-iron manufactured products."

TABLE I. ESTIMATED CONSTRUCTION COST OF ELECTRIC-DRIVEN 50,000,000-GAL. ACTIVATED-SLUDGE PLANT FOR CHICAGO STOCKYARDS DISTRICT

Items	Amount
Aeration tanks—32 units	$778,140
Settling tanks—32 units	122,090
Sludge tanks—8 units	30,880
Skimming basin—1 unit	13,000
Piping:	
Air	160,920
Sewage	46,700
Sludge	25,700
Drainage	57,050
Water and flushing pipes	5,000
Screen and pump house	120,260
Compressors, mechanical equipment, house, etc	564,080
Sludge press and drying house	784,340
Laboratory	7,500
Meter vault	5,920
Effluent conduits	11,350
Grading and grounds	59,300
Cofferdam and dock	94,000
Operating gallery	23,730
Intercepting sewer	124,650
	$3,034,610
Contingencies (omissions and engineering) 15%	455,190
Total	$3,489,800
Interest during construction	261,735
Grand total	$3,751,535

The estimated construction cost of the proposed plant just outlined is given in Table I and the annual charges in Table II.

The annual charges are based on the following, among other data: The labor schedule provides for three eight-hour shifts of 37 skilled operators ranging from super-

TABLE II. ANNUAL COST OF 50,000,000-GAL. ACTIVATED-SLUDGE PLANT FOR CHICAGO STOCKYARDS SEWAGE

Operating:		
Salaries, superintendence, etc	$7,900	
Labor, payroll	75,400	
Power	270,000	
Supplies and repairs	98,000	
		$455,700
Depreciation:		
Filtros—20% on $70,000	$14,000	
Screens—10% on $20,000	2,000	
Driers, etc.—7% on $350,000	24,500	
Boilers, etc.—5% on $570,600	28,530	
Structures—4% on $2,740,935	109,640	
		178,670
Interest:		
5% on $3,751,535		187,577
Total		$821,947

intendent and foremen to seamstresses (the latter for sludge filter cloths) and 61 laborers. The cost of power is based on the commercial rates of the Commonwealth Edison Co., ranging from 0.75 to 0.65c. per kw.-hr., or perhaps less.

Analyses by W. D. Richardson of the activated sludge from stockyards sewage show that it contains from 4 to 5.5% of nitrogen or 4.9 to 6.6% of ammonia. The value of the screenings is much less. On a 5% ammonia basis the fertilizing value of the sludge would be $12 a ton under normal and $18 under war conditions. Corresponding grease values are 7 and 4c. per lb. It is estimated that the grease can be reclaimed for 0.25c. per lb. and that 4c. per lb. is a safe estimate of its selling value under all conditions. The total revenue from grease and fertilizer base is estimated as ranging from $150,000 to $450,000, depending upon quantities recovered and market prices. Possibly the figures would run as high as $375,000 to $675,000, but the lower estimates are used in the final conclusions of the report.

As to the initial installation recommended, Mr. Pearse advises a fine-mesh screen, grit chamber and grease-skimming basin to handle the entire flow of sewage, besides one activated-sludge unit. Dr. Richardson agrees to all this except the grit chamber and grease basin.

Settlement Observed on Two Earth Dams in Porto Rico

Dam Filled Into Middle Pool Has Smaller Settlement Than One of Barrow-Placed Rolled Earth

By J. M. GILES
Chief Engineer, Porto Rico Irrigation Service, Guayama, P. R.

IN the irregation system built by the government of Porto Rico to furnish water for a portion of the dry zone on the south coast of the island, two of the large earth dams were closely observed for possible settlement over a period of three years.

Patillas dam is 135 ft. high above the river bed, has a crest length of 1020 ft. and contains 741,500 cu.m. of material. The crest width is 20 ft., the downstream slope 2 to 1, and the upstream slope varies from 3 to 1 to 2 to 1. The crest was arched in longitudinal section to allow for settlement. The material for the dam was excavated by steam shovels working within the reservoir site and was hauled to the dam on 8-yd. dump-cars.

Patillas Dam Built from Trestles

For the first 50 ft. in height the cars were dumped from two trestles, which were built along each face of the dam, the top of the trestles being at the slope line. After this height was reached, successive lifts were made by shifting the tracks back and forth. The material for the outer slopes was composed largely of boulders and gravel taken from the river bottoms. For the inner sides of the embankment the material was taken from the hillsides and higher bottoms and contained about 25% clay. After being dumped on the inner slopes, this material was washed down by means of hydraulic monitors and allowed to settle in a pool maintained between the two embankments and having a width equal to about one-fifth that of the dam at the same elevation.

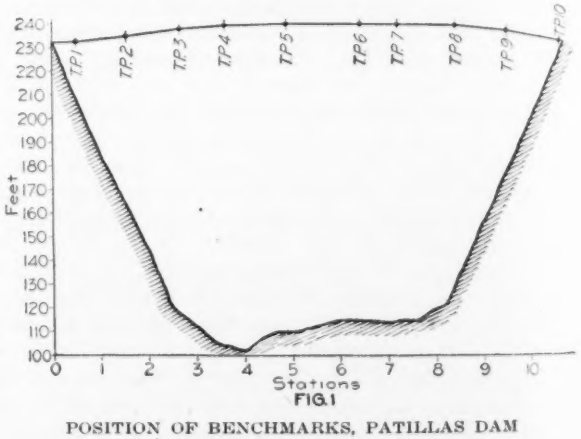


FIG.1

POSITION OF BENCHMARKS, PATILLAS DAM

TABLE I. SUBSIDENCE IN FEET IN PATILLAS DAM

B.M.	Elevation May 9, 1914	Elevation, Aug. 11, 1914	Elevation, May 21, 1915	Elevation, Apr. 13, 1917	Total Settlement to Date	Depth of Fill	Settlement per Foot Fill of Depth
1	232.14	232.14	232.14	232.14	0.0	24	0.0
2	234.48	232.42	234.39	234.29	0.19	71	0.0026
3	237.49	237.37	237.26	237.05	0.44	120	0.0037
4	239.00	238.86	238.70	238.48	0.52	135	0.0038
5	239.84	239.74	239.66	239.37	0.47	130	0.0036
6	239.30	239.15	239.02	238.75	0.55	124	0.0044
7	239.12	238.97	238.84	238.56	0.56	124	0.0045
8	238.82	238.66	238.59	238.27	0.45	109	0.0041
9	236.40	236.29	236.28	236.04	0.36	60	0.0060
10	232.06	232.00	232.00	231.96	0.10	4	0.025

The surplus water was at first drawn off by a vertical shaft and a culvert through the lower embankment, but later was wasted down the paved outer slopes. Water for sluicing was brought through about 8000 ft. of 16-in. and 12-in. pipe and delivered at the work at a maximum pressure of 88 lb. per sq.in. The pipe line was carried

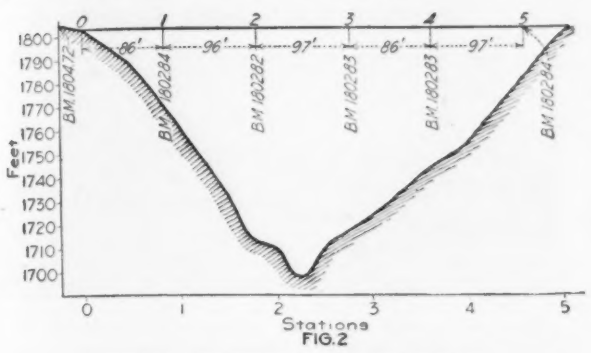


FIG. 2

POSITION OF BENCHMARKS, CARITE DAM

TABLE II. SUBSIDENCES IN FEET ON CARITE DAM

B.M.	Elevation, January, 1914	Elevation, Dec. 19, 1914	Elevation, July 12, 1915	Elevation, Feb. 27, 1917	Total Settlement to Date	Depth of Fill	Settlement per Foot Fill of Depth
1	2.84	1,802.62	1,802.52	1,802.42	0.42	34	0.0124
2	2.82	1,802.49	1,802.30	1,802.10	0.72	91	0.0126
3	2.83	1,802.27	1,802.14	1,801.87	0.96	85	0.0112
4	2.83	1,802.33	1,802.15	1,801.88	0.95	59	0.0163
5	2.84	1,802.47	1,802.33	1,802.25	0.59	20	0.0295

the length of the dam, supported on pontoons floating in the pool, the hydraulic monitors being placed at convenient intervals. When the dam reached such a height that the gravity pressure was not sufficient, a 6-in. centrifugal pump driven by a 60-hp. gasoline engine was installed on a pontoon together with two monitors, and the hydraulicking of the inner slopes was continued until there was no longer space for the pond.

After the dam had been completed, 10 benchmarks were painted on large stones used in paving the crest, and elevations were referred to a benchmark at the west end of the dam. The positions of these benchmarks are shown in the profile, Fig. 1. Table I gives the elevation taken at varying intervals since the dam was completed, Mar. 31, 1914.

Carite Dam Fill Placed by Hand

Carite dam is located in the mountains, where transportation is exceedingly difficult and rainfall heavy. Hand labor was largely used in its construction. The dam is 105 ft. high above the river bed, 520 ft. long on the crest and contains 155,000 cu.m. of material. The crest width is 20 ft., the downstream slope 2 to 1 and the upstream slope about 2.75 to 1. The dam was built to a uniform height of 5 ft. above theoretical lines. There was some surplus material to be taken from the spillway, and tracks being in place it was convenient to deposit it on the dam instead of wasting.

The greater part of the material used in the dam was taken from the spillway, which was cut through a ridge at the south end of the dam. This material was clay at the surface, changing to rotten rock, locally called "tosca," as the depth increased and finally to hard rock. There was barely enough of the latter to pave the upstream slope and the lower half of the downstream slope. The material was loosened by blasting and was shoveled into 4-yd. cars, which were dumped on the dam from trestles about 20 ft. high. It was then distributed by wheelbarrows and scrapers in layers of about 1 ft. thickness. These layers were rolled, weather permitting, by a traction engine, weighing about 10 tons. The finer material was placed in the middle third of the dam, sufficient clay being borrowed from adjacent hillsides to make a corewall at least 20 ft. thick. The upper 15 ft., above spillway level, was not rolled, because so much of the space was occupied by the trestle. Very little sprinkling was done, because the material was usually moist enough from rainfall. Quite frequently it was so wet that the traction engine could not be used for several days at a time.

When the dam was completed in January, 1914, five benchmarks were made by setting hardwood posts, with railroad spikes in their tops, along the crest. The position of these is shown on the profile, Fig. 2, and the elevations are given in Table II.

Government Operation and Canada's Railroad Problem

Samuel Rea Gives Views on Report of Royal Commission, and Different Conditions in the United States

IS THE form of railway administration advocated by Messrs. Acworth and Drayton [in the majority report, abstracted in *Engineering News-Record* of May 17, p. 353, of the Royal Commission created to study Canada's railway problem] substantially identical with government ownership and operation, or does it represent a third method? Is government operation a cure for bad or wasteful planning, location and construction of railway systems? These were two questions put by this journal in a letter to Samuel Rea, president of the Pennsylvania R.R., soliciting his views. It was suggested that the development of ideas in Canada might affect those in the United States. Mr. Rea replied as follows:

Sir—Replying to your letter of 21st ulto., the problem of Canadian Railways is so complex that I will not attempt any criticism of the various reports by men who have studied the matter closely. The situation impresses me like this:

Canada is in a separate and serious position of its own regarding its railroads. Only one large system is preeminently profitable, and the country is engaged in a serious war. Judged by either its population, its traffic or future growth, it has pursued too rapid and liberal a program of new railroad construction supported by governmental aid. The crux of the situation is, Who is to provide for the deficiency in earning the interest charges and operating expenses, and furnish the capital essential to finish and properly equip these lines in the next 10 years or more? Obviously, the only available source in sight that can shoulder that great responsibility is the Canadian Government. It is likewise obvious that the Government and people of Canada will scarcely assume all these obligations and at a future date permit private companies or stockholders to be beneficiaries, to whom would inure practically all the future equities.

The majority report apparently recognizes that financial and political difficulty, and while emphatically disapproving of Government operation, felt obliged in view

of the governmental responsibilities to recommend operation by a board of trained railroad and business men with practically a life tenure of office. This is an experiment and may fail, but to disinterested persons it would seem that some such coöperative plan must be adopted to meet with the approval of the Canadian people. The burden is too great to be left solely to private capital and private initiative, because there is no present nor immediately prospective earning capacity to warrant private capital in assuming that load, and all capital sources are being drained by the war.

As no such situation confronts the United States or its railroads, the recommendations in the majority report apply solely to the serious Canadian situation and do not, in my judgment, justify the United States Government considering the ownership and operation of $17,000,000,000 of railroad property and taking over nearly 2,000,000 employees with their voting influence, and depriving the Federal and state governments of $150,000,000 of taxes per annum now paid by the railroads. Our roads have been promoted and have developed the country in advance of its being populated, but often at great sacrifice by railroad owners and with very little governmental aid compared to the total investment, and with an exceedingly narrow margin of profit.

Under concentrated, responsible public regulation, which they have never had, the railroads of the United States will remain among the most efficiently operated lines in the world, paying the highest wages to labor, the highest taxes to the Government, and charging the lowest rates of any civilized nation. We have what I believe is superior to Government ownership—that is, an ownership by the people individually and through savings banks, insurance companies and other institutions, combined with the most enterprising and efficient railroad management of any country in the world. The pressing need is to relieve these national systems from unnecessary duplication and of confusing regulation, and concede them reasonable, remunerative rates, amply justified by rising costs and taxes, and the railroads will continue to be the most effective instrument for the country's prosperity and defense without the slightest governmental assistance. SAMUEL REA.

War Economies Used as Text To Preach Fire Prevention

The National Board of Fire Underwriters nas started a country-wide campaign against fire waste, using the present very apparent need for economy as a text to preach a lay sermon that will now attract attention where in former years it might have been disregarded by the people at large. The initial campaign is to be for the protection of the food storage; a special effort is to be made to correct structural hazards and promote careful fire protection and fire-fighting methods in granaries and storage warehouses, the destruction of which by fire is a regular item of news nowadays. A second line of attack will be toward all kinds of warehouses storing goods that are now scarce or promise to be scarce, and the last effort will be toward fire protection generally. Organizations of the local underwriters' associations have been made to act by general publicity and by direct appeal to owners, builders and city officials in their districts.

Road Division Headquarters Rearranged for Efficiency

A Yard and Building Interior in Los Angeles County Road System Laid Out for Greatest Convenience and Space Economy

GENERAL VIEW OF ROAD DIVISION HEADQUARTERS

THE Baldwin Park division headquarters of the Los Angeles County Road Department has been rearranged with an eye to convenience and efficiency of operation. In the present arrangement are several ideas that have been found most successful and that might be applied on other road systems. This division headquarters is about 20 miles from the City of Los Angeles. From it as a distributing point are carried on the extension, repair and general maintenance required on 150 miles of paved roads and 800 miles of oiled, gravel and dirt roads of the Los Angeles County highway system.

The main building at Baldwin Park headquarters is a one-story galvanized-iron structure, 55 x 66 ft. in plan, with a concrete floor. In this building are the engineers' office, blacksmith shop, storage space for cement, dressed lumber, sacks and all such materials and tools as require housing. The ample yard affords space for parking graders, wagons and heavy equipment in general. A separate building is provided for storing oil and the equipment for applying it.

ELEVATED "BOX OFFICE"

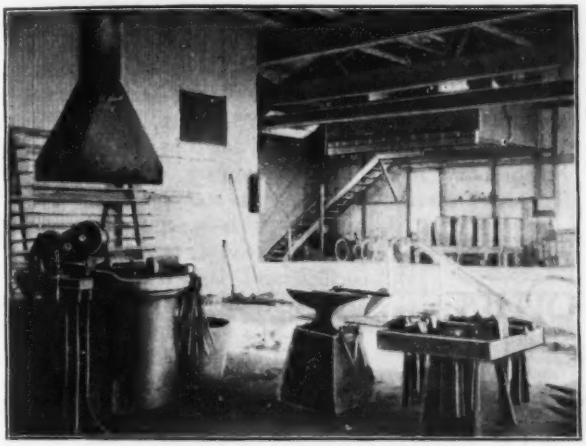
The main building as originally laid out and put in service had the engineers' office in one corner of the cement storeroom. In this location the office received its light chiefly through windows opening into the interior of the building—certainly not an ideal location. After the headquarters had been in use a while, a number of changes and improvements were made.

The first of these was the construction of a new office in the south gable end of the building at a height that allows a 10-ft. clearance between the floor of the building and the bottom of the new office, which is 12 x 12 ft. in plan and is suspended by ¾-in. rods from the roof trusses. In addition to two outside windows facing south, which afford good light and air, there are three windows opening into the interior of the building. Through them a general view may be had of the entire main floor.

Access is by means of a stairway against the building walls in a corner where it does not interfere with the floor space. In fact, in addition to increasing efficiency and satisfaction among the men, putting the office in this position increased the floor space just that much, because as now located there is ample headroom under it for the storage of any equipment that can be brought indoors.

The forge has been placed near the center of the floor area devoted to blacksmith work, so it is conveniently accessible from all sides. To overcome the chimney problem that arises when the forge is not placed next the building wall, sections of corrugated pipe intended for culverts were requisitioned for service as a chimney and are held in place vertically over the forge by supports running to the roof trusses. Blacksmith-work orders are regularly chalked up on a large blackboard. This facilitates keeping a check on the work and saves time.

The floor of the cement storeroom, for convenience in loading trucks, was built at a height of 4 ft. above the main-floor level. The space beneath this storeroom has been made most convenient for the storing of dressed lumber by making it accessible from the outside of the building through two 3 x 16-ft. doors hinged at the top. The length of each piece of lumber is marked on its end with chalk as it is put into this inclosed space, so that the



INTERIOR VIEW; NOTICE THE ELEVATED "BOX OFFICE"

pieces desired can be quickly located by inspection from the outside.

A policy has been established on this division of keeping a very close check on all construction and maintenance equipment issued to it. When equipment has been broken or partly worn out, it is brought promptly to the division headquarters; and if a part or all of it can be made serviceable by repair, it is stored with other discarded equipment until the blacksmith can attend to it without delaying other work. One blacksmith and a helper are employed steadily. When not engaged in work immediately attendant upon construction or maintenance in hand, there is always work for these men in repairing or rebuilding discarded equipment. This policy has resulted in keeping equipment assigned to the division in condition for emergency use and on several occasions this has proved most convenient.

The yard in which the main structure stands is kept well graveled and clean. Scarifiers, scrapers and plows are parked in rows that simulate military array, and the general air of the headquarters is neat and orderly. Within the past two years there has been built on this division about 15 miles of extension of oil-surfaced concrete base road, chiefly 20 ft. wide, and 20 miles of oiled macadam pavement; and 500,000 sq.yd. of re-oiling on macadam roads has been done.

F. H. Joyner is commissioner of the Los Angeles County Road Department; A. B. Smith is division engineer in charge of the Baldwin Park Division and H. J. Parker, foreman.

Developing Residence District for Industrial Workers

Tract on Outskirts of San Francisco Is Being Built Up To Encourage Mechanics To Buy Homes

A NINETY-ACRE tract of land on the southern boundary line of the City of San Francisco has been purchased and is being laid out and improved as a district in which the average industrial worker will be able to purchase his own home. The conditions leading to this movement, which is fostered by the Chamber of Commerce and public-spirited citizens, are that building lots in the residential districts of San Francisco are far beyond the reach of the average mechanic; and as a result the steadiest and best class of workmen have been locating in cities across the bay. This action has tended to attract industries to those cities rather than to San Francisco.

The project contemplates the construction of a large number of small houses which will be sold on such terms that the monthly installments will amount to about the same as the rental such families usually pay, the total cost to be about $2500 or $3000. The improvement of the entire tract at once and the favorable location of lines of transportation, schools, retail-market centers, etc., make it possible to offer the industrial worker a proposition that is expected to have a notable effect on the San Francisco labor problem.

Houses of Bungalow Type

The single houses are to be, in general, of the bungalow type, containing four rooms and bath and all modern conveniences. The prices fixed on 50 x 100-ft. lots average less than $500. Other quarters for unmarried men are contemplated, and it is expected that the plan will be based on somewhat the same idea as the "community houses" in England's industrial districts.

The plans contemplate the ultimate accommodation of 15,000 people in this district, which is not far from the new Southern Pacific shops, where about 5000 men are employed. The site is also near the large dry dock under construction at Hunters Point and is within easy reach of what is known as the industrial section of the city.

Geological Survey of California

About 40,000 square miles, or 26%, of the total area of California has not been mapped by the United States Geological Survey. Almost half this unmapped area lies in fertile and productive territory, and 20 or 30 years would be required to complete the maps at the present rate of progress. At present the annual appropriation by the state legislature is $14,000. Since state appropriations are supplemented by an equal amount of Federal funds, organized effort on the part of engineers is being directed toward increasing California's appropriation to $25,000.

ENGINEERING LITERATURE

A Review of Books and a Listing of New Publications

Milestones in Engineering Science

Marked by Newton—Euler—Young—Whipple—Weisbach—Rankine—Unwin

By R. FLEMING

American Bridge Co., New York City

IN THIS article attention is called to a few notable milestones in the history of engineering science. A large part of this history is still unwritten. What can be done is shown in the monumental work of Todhunter and Pearson, "A History of the Elasticity and Strength of Materials." The 2250 pages of the two volumes are a marvel of erudition and patient research. The authors show future historians safe paths to follow, of which the path to first sources is one.

Firm foundations were laid when in 1687 Newton published his "Philosophiæ Naturalis Principia Mathematica," or "The Mathematical Principles of Natural Philosophy"—familiarly known as the "Principia." A revised edition was issued in 1714 and another in 1726. The three laws of motion are stated at the beginning of the first book, and the science of hydro-mechanics had its birth in the second book. The "Principia" was the leading book of the century in the realm of science. In his "History of Mathematics," Ball says:

"No other treatise of the same epoch-making character as the first part of the 'Principia' has ever been produced. . . . If the state of mathematical knowledge in 1669 be compared with what was known in 1687 it will be seen how immense was the advance. In fact we may say that it took mathematicians half a century or more before they were able to master and assimilate the work which Newton had produced in those twenty years."

It is difficult to exaggerate the work of Newton. To him we owe the binomial theorem and the elements of calculus. We heard in our boyhood days the story of Newton and the apple. The story may be mythical, but Newton's statement of the law of gravitation remains undisputed.

In the memoirs of the Berlin Academy for the year 1757 there is a paper, "Sur la Force des Colonnes, par M. Euler," in which the column formula bearing the author's name is developed. It is the "mother of a mighty race" of column formulas. Leonard Euler was one of the great physicists, astronomers and mathematicians of the eighteenth century. He wrote several books and an immense number of memoirs. The symbols e for the base of the Napierian system of logarithms and π for the ratio of circumference to diameter have been generally used since Euler adopted them in his "Introductio in Analysin Infinitorum," 1748.

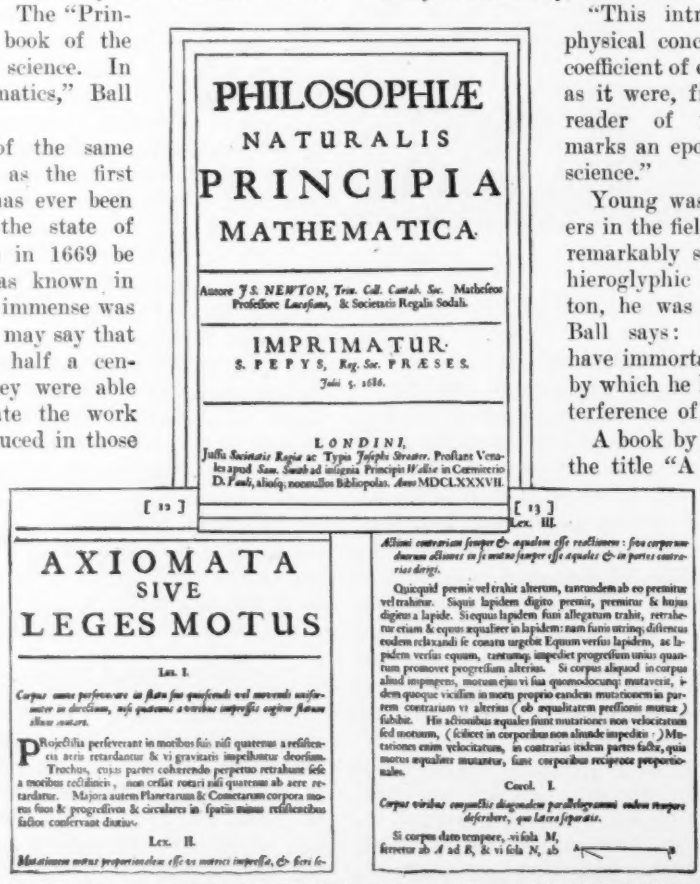
The introduction of the term "modulus of elasticity" marks another milestone in the progress of engineering science. In the second of two large quarto volumes, "A Course of Lectures on Natural Philosophy," 1807, by Thomas Young, there is a section entitled "Of the Equilibrium and Strength of Elastic Substances." The modulus of elasticity is defined almost at the beginning of the section. It may be noted that Young defines his modulus as a volume. What we now call the modulus is the weight of the column divided by the area of its base. Love, in the introduction to his "Mathematical Theory of Elasticity," makes this statement:

"This introduction of a definite physical concept, associated with the coefficient of elasticity which descends, as it were, from a clear sky, on the reader of mathematical memoirs, marks an epoch in the history of the science."

Young was one of the early workers in the field of Egyptology and was remarkably successful in deciphering hieroglyphic inscriptions. Like Newton, he was an authority on optics. Ball says: "The researches which have immortalized his name are those by which he laid down the laws of interference of waves and of light."

A book by Squire Whipple, bearing the title "A Work on Bridge Building, consisting of Two Essays, the one Elementary and General, the other giving Original Plans and Practical Details for Iron and Wooden Bridges," was published at Utica, N. Y., in 1847. Of this modest volume of 120 pages Professor Johnson says:

"This is a remarkable book. The author not only has correctly analyzed bridges for both static and moving loads, correctly dimensioning all



PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA

Autore Js. NEWTON, Trin. Coll. Cantab. Soc. Matheseos Professore Lucasiano, & Societatis Regalis Sodali.

IMPRIMATUR
S. PEPYS, Reg. Soc. PRÆSES.
Julii 5. 1686.

LONDINI,
Justu Societatis Regiæ ac Typis Josephi Streater. Prostant Venales apud Sam. Smith ad insignia Principis Walliæ in Cœmeterio D. Pauli, aliosq; nonnullos Bibliopolas. Anno MDCLXXXVII.

[12]

AXIOMATA
SIVE
LEGES MOTUS

Lex. I.

Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum illum mutare.

Projectilia perseverant in motibus suis, nisi quatenus a resistentia aeris retardantur & vi gravitatis impelluntur deorsum. Trochus, cujus partes cohærendo perpetuo retrahunt sese a motibus rectilineis, non cessat rotari nisi quatenus ab aere retardatur. Majora autem Planetarum & Cometarum corpora motus suos & progressivos & circulares in spatiis minus resistentibus facilius conservant diutius.

Lex. II.

Mutationem motus proportionalem esse vi motrici impressæ, & fieri secundum lineam rectam qua vis illa imprimitur.

[13]

Lex. III.

Actioni contrariam semper & æqualem esse reactionem: sive corporum duorum actiones in se mutuo semper esse æquales & in partes contrarias dirigi.

Quicquid premit vel trahit alterum, tantundem ab eo premitur vel trahitur. Siquis lapidem digito premit, premitur & hujus digitus a lapide. Si equus lapidem funi allegatum trahit, retrahetur etiam & equus æqualiter in lapidem: nam funis utrinq; distentus eodem relaxandi se conatu urgebit Equum versus lapidem, ac lapidem versus equum, tantumq; impediet progressum unius quantum promovet progressum alterius. Si corpus aliquod in corpus aliud impingens, motum ejus vi sua quomodocunq; mutaverit, ipsum eodem quoque viribus in motu proprio eandem mutationem in partem contrariam vi alterius (ob æqualitatem pressionis mutuæ) subibit. His actionibus æquales fiunt mutationes non velocitatum sed motuum, (scilicet in corporibus non aliunde impeditis.) Mutationes enim velocitatum, in contrarias itidem partes factæ, quia motus æqualiter mutantur, sunt corporibus reciprocæ proportionales.

Corol. I.

Corpus viribus conjunctis diagonalem parallelogrammi eodem tempore describet, quo latera separatis.

Si corpus dato tempore, vi sola M, ferretur ab A ad B, & vi sola N, ab

THE FIRST MILESTONE HERE MARKED IN NEWTON'S "PRINCIPIA"

Title page and pages 12 and 13 from the original edition, published in London in 1687 and bearing the name of the famous diarist, Samuel Pepys, then president of the Royal Society. The pages are reproduced from a copy originally owned by the Astor Library, now a part of the New York Public Library

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SUR

LA FORCE DES COLONNES.

PAR M. EULER.

I.

Quand je dévelopai dans le ſupplément de mon Traité ſur les lignes périmetres les courbes des lames élaſtiques, j'en ai tiré une régle pour juger de la force des colonnes, qui me parut dabord fort remarquable. Il s'agit de déterminer le poids qu'une colonne peut ſoutenir, ſans être ſujette à ſe plier. La Régle que j'ai trouvée, regarde les colonnes, qui ſont également fortes par toute leur longueur; & ſi l'on nomme la hauteur d'une telle colonne = a, & le moment de ſon reſſort = Ekk, dont j'ai expliqué tant la ſignification, que les moyens pour en trouver la juſte valeur en chaque cas; le poids que cette colonne eſt capable de ſoutenir ſans ſe plier, eſt = $\pi\pi \cdot \frac{Ekk}{4aa}$, où π marque la circonference d'un cercle dont le diametre eſt = 1: d'où l'on voit que ce poids ſuit la raiſon renverſée du quarré de la hauteur de la colonne. Mais pour faire uſage de cette régle, il eſt bon que je rapporte ici ce qu'il faut entendre par l'expreſſion Ekk, que je viens de nommer *Moment du Reſſort*.

LEONHARD EULER'S COLUMN FORMULA WAS DEVELOPED IN A PAPER BEGINNING AS ABOVE

From "Histoire de L'Académie Royale des Sciences et Belles Lettres" for the year 1757, published in Berlin two years later (1759). Note the use of π in the excerpt. The symbol was adopted by Euler in a work published in 1748. Reproduced from copy in New York Public Library

members, including all counters, but he computes the various 'strain lengths' of various styles of bridges and compares their relative weights in this manner."

Whipple was the originator of the well-known Whipple truss and a pioneer builder of iron truss bridges, but the distinguishing honor attached to his name is that he first analyzed correctly the stresses in a bridge truss.

The historian of technical education will give a large place to the works of Weisbach and Rankine. They are so far in advance of earlier textbooks that they mark the beginning of a new era. The first volume of Weisbach's "Ingenieur-Mechanik" appeared in 1846. An English translation was printed in London, 1848, and an American edition in Philadelphia, 1849. Weisbach enlarged and revised his original work several times. Translations have been made into a number of European languages. Professor Du Bois, in his translation of Volume II, says:

"This is almost the sole objection which can be brought against Weisbach's work—viz.: its fullness. As to the rest, it will be found the work of a skillful and experienced teacher, written expressly for young students, clear, simple, and thorough, and especially adapted for class instruction, while at the same time it forms a standard book of reference for the mechanic and constructor."

We proceed to the mighty name of Rankine. His "Applied Mechanics" was first published in 1858. It has passed through many editions, but so thorough and complete was the first edition that subsequent revisions and additions have been slight. According to Todhunter and Pearson, we owe to Rankine the scientific differentiation and appropriation of the terms stress, strain and shear. Like Euler, Rankine was a voluminous writer and an intellectual giant. To read him with ease is a hallmark of distinction. Professor Woodward, in the preface to his "Rational and Applied Mechanics," says of Rankine:

"His profound insight into the conditions of a problem, and his ready command of the methods of mathematics made difficult things seem so easy to him, that he failed to see the pits into which his students fell. His reasoning was almost subconscious, and he was given to writing down the second equation first, and then deriving the first from the second."

The last milestone that will be noted brings us within 50 years of our own time. In 1868, Unwin, chiefly known as an authority on machine design, delivered a series of six lectures on bridge and roof design. These were published with an appendix in 1869 under the title "Wrought Iron Bridges and Roofs." This volume of 179 pages and 12 plates is rich in suggestions. Unwin was a generation ahead of his time. Two instances will be cited. In the first lecture he anticipates the abandonment of the term "factor of safety." Thus:

"Probably in the future of engineering, empirical formulas for the ultimate strength will be more and more discarded. It is, to say the least, a roundabout proceeding to calculate the breaking weight, and then to divide it by an assumed factor of safety to find the safe load. The safety of the structure will be more directly assured by estimating the actual stresses, and by providing such an amount of material that the intensity of the stress shall nowhere exceed three, or four, or five tons per square inch, or whatever limiting stress is shown by experience to be suitable for the material."

In the second lecture he advocates that a

SECTION IX. OF THE EQUILIBRIUM AND STRENGTH OF ELASTIC SUBSTANCES.

318. DEFINITION. A substance perfectly elastic is initially extended and compressed in equal degrees by equal forces, and proportionally by proportional forces.

319. DEFINITION. The modulus of the elasticity of any substance is a column of the same substance, capable of producing a pressure on its base which is to the weight causing a certain degree of compression, as the length of the substance is to the diminution of its length.

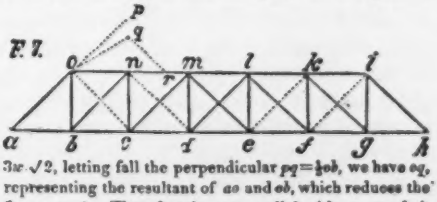
320. THEOREM. When a force is applied to an elastic column, of a rectangular prismatic form, the cohesive and repulsive forces must therefore be as $a+\frac{bb}{36a}-\frac{1}{2}b$ to $a+\frac{bb}{36a}+\frac{1}{2}b$, since that which serves as the fulcrum of the lever must bear a force equal to the sum of the two forces applied at the ends, which are proportional to the opposite arms of the lever; or as $36aa-12ab+bb$ to $36aa+12ab+bb$, that is, as $(6a-b)$ to $(6a+b)^2$: but these forces are actually as the squares of the sides of the similar triangles which represent them, that is, as $\left(\frac{1}{3}a-\frac{bb}{12a}\right)^2$ to $\left(\frac{1}{3}a+\frac{bb}{12a}\right)^2$, or as $(6a-b)^2$ to $(6a+b)^2$, which is the ratio required: there will therefore be an equilibrium under the circumstances of the proposition.

321. THEOREM. The weight of the modulus of the elasticity of a column being m, a weight bending it in any manner f, the distance of the line of its application from any point of the axis, a, and the depth of the

FIRST APPEARANCE OF MODULUS OF ELASTICITY

From first edition of Thomas Young's "A Course of Lectures in Natural Philosophy," Volume II, London, 1807. Reproduced from a copy in the Library of the United Engineering Society, New York City.

which ao has just been found equal to $3w\sqrt{2}$, and ob is equal to w, being simply the weight resting at the point o. Then, extending ao and taking $op=ao$ to represent



$3w\sqrt{2}$, letting fall the perpendicular $pq=\frac{1}{2}ob$, we have oq, representing the resultant of ao and ob, which reduces the forces to 3. Then drawing qr parallel with oc, qr obviously represents the tension of oc, which is equal to $2w\sqrt{2}$, and or represents the thrust of on, which is equal to $5w$. The tension of bc is $3w$, the same as that of ab, since the parts ob and bn have no action.

WHIPPLE WAS THE FIRST TO ANALYZE CORRECTLY BRIDGE-TRUSS STRESSES

Part of page 12 of Squire Whipple's "A Work on Bridge Building," published at Utica, N. Y., in 1847. Reproduced from a copy in the Library of the American Society of Civil Engineers, New York City.

smaller working stress be used for live than for dead loads, as follows:

"In calculating the sectional areas of metal for a bridge, therefore, since the precise stresses to which a live load will give rise cannot be ascertained, either of two courses may be pursued: (1) The load may be reduced to an equivalent dead load, whose magnitude will be twice the actual live load + the dead load. In proportioning the girder a limiting stress suitable to a dead load may then be taken. (2) The stresses may be calculated from the actual load, considered as a dead load, and a variable limiting stress may be adopted, dependent on the ratio of the dead to the live load."

REVIEWS AND NOTES

Modern Ventilating Practice

Reviewed by D. D. KIMBALL
Of Richard D. Kimball Co., New York City

SOME MODERN METHODS OF VENTILATION, with Special Reference to Public Buildings, Standards of Ventilation, Design of Ducts, Selection of Fans, Washers and Heaters, Specifications, Test Forms and Specimen Schedules for Designers—By R. Grierson, Assoc. M. Inst. M. E., Assoc. M. Inst. E. E. New York: D. Van Nostrand Co. Cloth: 6 x 9 in.; pp. 187; 37 illustrations. $3 net.

The author's expressed purpose is to present, in as simple and concise a form as possible, the general principles and practice of design of a modern ventilating plant. This is accomplished as fully as could be expected in a book of less than 200 pages. Although the book will scarcely meet the needs of the student beginner in this subject, nor completely satisfy the needs of the well-informed engineer, yet it may well interest both and it is a desirable addition to any library on the subject of ventilation. The descriptions and definitions are models of conciseness and clearness.

Although based upon English practice, it presents American practices more fully and correctly than any other British book on this subject known to the reviewer. Many of its 40 tables are from American authorities, and all are in accordance with the most modern practice. A similar statement would apply to the illustrations.

A half-dozen points worthy of consideration in the early second edition that may be hoped for may be noted: (1) It is evident that the author is misinformed as to the extent to which the recirculation of air is practiced in ventilation work in this country. This practice may not yet be said to be approved except under special conditions. (2) Placing the limit of heat elimination of a person at "heavy manual labor" at 550 B.t.u. per hour would appear to be in error. (3) The limitations of the upward system of ventilation are not properly considered. (4) We are still without scientific data warranting the author's statement that "any complete system must include an air washer and *humidifying* plant." Harmful effects of dry air to the human being have yet to be demonstrated. (5) It is very doubtful if ozone may be a factor in the ventilation of buildings, for which reason this subject should be given less space. (6) The chapter on guarantees is much too brief, and the suggested schedules for designing are rather too complicated for general use.

The author is especially to be commended for his forceful argument in favor of proper coöperation between architect and engineer in the preparation of plans for modern buildings and their equipment. As a whole, the book appears to be the product of one who is thoroughly versed in the theory and practice of modern ventilating work.

Popularizing Engineering Work

THE CONQUERORS—A special publication by the Cleveland Engineering Society, Chamber of Commerce Building, Cleveland, Ohio. Paper; 7 x 10 in.; pp. 102; many illustrations. 25 cents.

In an effort to "familiarize the public with fundamental ideas concerning the inception and carrying through of engineering work," the society already named, with the aid of the Washington Society of Engineers, offers this pamphlet as an aid to the work of the Committee on Coöperation. The pamphlet contains the following papers: "Peacefulness and Greatness of the Earliest Engineers," by George H. Johnson; "Making Homes in the Desert," by F. H. Newell; "Public Water-Supply," by George W. Fuller; "Transportation," by A. W. Johnston; "Some Notable Masonry Bridges," by Henry S. Jacoby; "Measurement of Stream Flow by the United States Geological Survey," by John C. Hoyt; "Recent Developments in Naval Architecture," by Charles F. Gross.

Red Lead for Paint

RED LEAD AND HOW TO USE IT IN PAINT—By A. H. Sabin, New York City (111 Broadway); The Author. Cloth; 4 x 7 in.; pp. 86; illustrated. $1.

The author presents the advantages of red lead from the viewpoint of a manufacturer's paint expert. He describes the importance of purity and states when the addition of such pigments as litharge and lamp black is useful. The preparation of red lead in oil for different kinds of service is discussed, and the preliminary treatment of the surface to be protected is described. The book contains a vast amount of handy, practical information for the paint user and for the engineer who has to write painting specifications.

Concrete-Design Tables

REINFORCED-CONCRETE DESIGN TABLES: A Handbook for Engineers and Architects for Use in Designing Reinforced-Concrete Structures—By M. Edgar Thomas and Charles E. Nichols. New York: McGraw-Hill Book Co. Flexible leather; 4 x 7 in.; pp. 208. $3 net.

The authors of these tables show a bold disregard for the curious psychology that surrounds the preparation and use of tables or diagrams for the designing of reinforced concrete. Possibly they do not know this manifestation; but if they had put in a number of years as editors of technical journals, they would realize that no engineer will use for the designing of reinforced concrete a diagram or a table that has been made by anyone else. Rather, he will put in laborious hours carefully working out a table and diagram or diagrams of his own, which, if need be, he will defend in impassioned letters to the editor, proving that this table and no other, or this diagram and no other, is the last word in the art.

It would be too bad, however, if this attitude persisted in the consideration of Messrs. Thomas and Nichols' tables, for they are complete and easy of reference. They are made primarily for design, so that in using them to investigate designs, somewhat cumbersome methods have

to be gone through with. For design, though, the presence of every possible variation of unit stress and modulus ratio together with most convenient and attractive typographical arrangement, make probable the defeat of the hoodoo against such matter.

Nation-Wide Survey of City Planning

CITY PLANNING PROGRESS IN THE UNITED STATES, 1917—Compiled by the Committee on Town Planning of the American Institute of Architects. Edited by George B. Ford, assisted by Ralph F. Warner. Washington, D. C.: The Journal of the American Institute of Architects. Paper; 8 x 11 in.; pp. 207; many illustrations. $1.70 in paper; $2.20 in cloth.

Valuable service has been rendered by the production of this survey of city-planning effort—and lack of effort—in 233 cities and towns of the United States. Information obtained from authentic published reports or from signed reports by responsible authorities is presented for every city and town of 25,000 or less (1916 Census estimates) and for some smaller places.

The review for each city and town is a readable account of local city-planning activities, whether private, semi-public or public. Maps and halftones are freely used. A "Summary" of four pages is devoted chiefly to progress at home and abroad in various lines during 1917. This is followed by four pages of city-planning references, by Theodora Kimball, Harvard University.

In the revised and extended edition promised early in 1919 it is to be hoped that an attempt will be made to bring out clearly for each city just what has been accomplished in the realization of the reports and plans reviewed. Where nothing has been done, it would perhaps help the cause, both locally and generally, to say so instead of leaving the reader to draw his own conclusions. The need for more definiteness may well be illustrated by the case of Hartford, Conn. This city, the uninformed reader has brought home to him, "was the first American city to have a permanent city-planning commission authorized by legislative act." The commission dates from 1907. What has been accomplished in the 10 subsequent years? The inference is that nothing has yet been done toward carrying out the recommendations of Carrere & Hastings, made in a report published in 1911 after some delay.

Highway Laws Analyzed and Reviewed

HIGHWAY LAWS OF THE UNITED STATES: A Topical Discussion—By A. N. Johnson. [No. 82, February, 1917, issue of "Municipal Research."] New York (261 Broadway): Bureau of Municipal Research and Training School for Public Service. Paper; 6 x 9 in.; pp. 163. $1.

This study, made under the auspices of the Rockefeller Foundation's Committee on Scientific Research in Government, by A. N. Johnson, is published at present only in pamphlet form for current use, due to the fact that a revision of highway laws is now under consideration in a number of states. In the author's introduction, attention is called to the fact that the present prominence of the road question has been and is likely to be productive of many hastily considered laws, full of conflicting provisions and much overlapping of authority. It is shown that, while our highway laws are generally distorted by the old persuasion toward highly localized governmental control, the most important function of a state road law should be to make possible the adoption by a central authority of a definite, well-considered road policy. The well-codified laws of Massachusetts, New York, New Jersey, Illinois and Ohio furnished the material from which an outline has been prepared, covering in very interesting detail the necessary features of a workable law. Facts and figures concerning the details, methods of operation and the effect of the highway laws of the several states are presented, and their advantages and disadvantages receive commendable treatment.

Chemistry of Materials

CHEMISTRY OF MATERIALS OF THE MACHINE AND BUILDING INDUSTRIES—By Robert B. Leighou, Sc.B., Associate Professor of Chemistry in the Carnegie Institute of Technology. New York: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. xv + 449; 75 illustrations. $3 net.

Neither a handbook nor a treatise, this volume is intended by the author to "supply information concerning the chemical properties of the materials employed in the various courses in Building Construction and Equipment, and in Machinery Construction and Operation, so that these materials might be used more intelligently and therefore to a better advantage."

Announcing an attempt to meet the needs of the user, it is hard to understand the allotment of space among the 20 chapters. Glue receives 12 of the 433 pages; "Clay and Clay Products," one less; "Primary Electric Cells," 18 pages (only one less than portland cement); while "Paints, Varnishes, Stains and Fillers" together run three more pages than "Iron and Steel."

There is a curious admixture of the scientific and the popular methods of treatment. The references are many and interesting, though it is to be doubted whether the technical student will be other than bewildered by their number, or the user of materials, seeking detailed information, will be less than exasperated by the glossing of facts indicated by their unceasing recurrence.

Water-Supply to Nonresidents

SUPPLYING WATER BY CITIES TO NONRESIDENTS—Data Gathered by the State Bureau of Municipal Information of the New York State Conference of Mayors and Other City Officials, Albany, N. Y., W. P. Capes, Director. White Plains, N. Y.: Public Affairs Information Service. Paper; 14 x 11 in.; pp. 3. 75c.

Text in tabular form on practice in New York State, giving statutory authority, rates and salient points in contracts. By folding once, the document becomes 7 x 11 in. in size. The publisher now distributes reports on special inquiries for the bureau named and also for other coöperative institutions, some of the reports being printed and others typewritten. The publisher also indexes *Engineering News-Record* and some other technical publications, as explained in a bulletin that can be had for the asking.

Stone-Filled Sheet Asphalt

PAVING ECONOMY: ROAD AND STREET—By Charles A. Mullen. Montreal, Canada: Industrial and Educational Press. Paper; 6 x 9 in.; pp. 98, $1.

Reared in a family engaged in various branches of the paving industry, the author of this pamphlet gained a practical experience in the contracting game, to find himself in control of and responsible for the street-paving policy of the City of Milwaukee in 1910. Now director of the paving department of the Milton Hersey Co., inspectors, engineers and industrial chemists, he offers the results of his experience, advocating as the most economical type of pavement the so-called "stone-filled sheet asphalt" surface. This specification, which is not patented, is explained at some length and justified by reference to work done by the author under its provisions.

Selling Personal Service

SELLING YOUR SERVICES—New York: The Sales Service Co. Paper; 6 x 8 in.; pp. 176. $1.

There is one product which most men have to sell at least once and which engineers generally have to sell much oftener, and that is personal service. Obviously, the first step in selling services to advantage is to make those services valuable, which is the object of a technical education and the "experience" that young engineers strive so hard to accumulate.

Most engineers are unfortunately far better mentally equipped and trained to acquire valuable knowledge and experience than to dispose of it to the financial advantage of themselves. To such this little book, outlining in a clear and forceful way the elements underlying all salesmanship, written particularly for the man who has only his services to sell, will be useful and inspiring.

Handling Mine Supplies

THE EFFICIENT PURCHASE AND UTILIZATION OF MINE SUPPLIES—By Hubert N. Stronck, E.M., M. Am. Inst. Min. E., and John R. Billyard, E. M., Mining Engineer. New York: John Wiley & Sons. Cloth; 5 x 8 in.; pp. 97; 24 illustrations. $1.25 net.

Dealing more extensively with the utilization than with the purchase of supplies, this book contains many suggestions for handling the business of storekeeping on construction work. Many of the methods outlined, however, are valuable only in handling very large stocks and would not apply to keeping the storehouse on a construction contract unless the work involved several million dollars. In general, the book outlines the modern filing, record and index systems suited to the use of a purchasing office and storekeeping organization.

How Small Stream Gets Away with Sewage

STUDIES ON THE DIGESTION OF A SEWAGE-FILTER EFFLUENT BY A SMALL AND OTHERWISE UNPOLLUTED STREAM—By Robert Spurr Weston and C. E. Turner; with Introduction by W. T. Sedgwick. Contributions from the Sanitary Research Laboratory and Sewage Experiment Station, Massachusetts Institute of Technology, Cambridge, Mass. Paper; 6 x 9 in.; pp. 96; maps, diagrams, halftone and other colored plates. $1.

A biological and chemical study of the effect of discharging treated filtered Brockton sewage into the Cowceset "stream." Brockton has a population of 65,000. The stream has a flow of 500,000 to 25,000,000 gal. a day. The studies covered the two years ended Feb. 1, 1916.

The pamphlet announces the death of the anonymous donor who made possible the valuable research work reported in this and earlier volumes. It also discloses the fact that this donor "was a lady, fond of books, of music and of painting."

Water and Mineral Witching

THE DIVINING ROD: A HISTORY OF WATER WITCHING—With a Bibliography by Arthur J. Ellis. Water-Supply Paper 416. Washington, D. C.: United States Geological Survey. Paper; 6 x 9 in.; pp. 59; illustrated. 10c., from the Superintendent of Documents.

Divided about equally between a historical review, with quotations from the more notable writers, and a bibliography, this pamphlet cannot fail to entertain those who wish a half-hour's amusement, as it will afford those who so desire ample opportunity to pursue the subject until they tire of it. The publication has been deemed necessary to meet the requests of inquirers for information—which shows that the fools and the curious are by no means all dead yet. An interesting introductory note by O. E. Meinzer closes with the statement that all inquirers who ask advice are warned against expending "any money for the services of any 'water witch' or for the use or purchase of any machine or instrument devised for locating underground water or other minerals."

Activated-Sludge Bibliography

THE ACTIVATED-SLUDGE PROCESS OF SEWAGE TREATMENT: A Bibliography of the Subject with Brief Abstracts, Patents, News Items, etc., Compiled from Current Literature. By J. Edward Porter, Chemical Engineer, General Filtration Co., Inc. Rochester, N. Y.: General Filtration Co. Paper; 6 x 9 in., pp. 40. 25 cents.

A hearty welcome should be given to this useful and well-made bibliography. The entries are chronological, from the two for 1913 up to May 3, 1917. Over 80 of them are to *Engineering News-Record* and its two predecessors. An index of authors and chronological lists of references to each of the journals included in the bibliography are given.

Another valuable feature of the pamphlet is a series of "Definitions" applicable to the activated-sludge process, prepared by F. A. Dallyn, George T. Hammond and T. Chalkley Hatton, a committee for the purpose, appointed at an informal meeting held during the convention of the American Society of Civil Engineers at Pittsburgh, June, 1916.

Reprints from "Mineral Resources"

Separates may be obtained, reprinted from "Mineral Resources of the United States, Part II," on the production of "Coal," "Coke," "Stone," "Clay-Working Industries and Building Operations in the Larger Cities," "Natural Gas" and "Artificial Gas and By-Products," in 1915, from the United States Geological Survey, Washington, D. C.

Committee Will Standardize Methods

Symbols used in mechanics and hydraulics are to be standardized by a committee of the Society for the Promotion of Engineering Education. The diversity of symbols used in textbooks, criticized by R. Fleming in *Engineering News-Record* of Apr. 12, 1917, p. 102, is an unfortunate condition of which engineering teachers are well aware. The committee on technical nomenclature aims to better this condition. Prof. J. T. Faig, of the University of Cincinnati, chairman, desires to receive ideas and suggestions concerning symbols in the two branches above noted.

Earth, Sand-Clay and Gravel Roads

On account of the wide distribution of earth roads and their close relationship to sand-clay and gravel surfaces, public interest in these three types is both genuine and general and gives ample warrant for the issuance by the Office of Public Roads and Rural Engineering (Washington, D. C.) of a bulletin on "Earth, Sand-Clay and Gravel Roads." In 68 pages Charles H. Moorefield, Senior Highway Engineer, treats of location, design and maintenance, and in an appendix he gives typical specifications for these three kinds of roads. There are numerous photographs of roads in various stages of construction, and of road-building machinery. Recommended cross-

sections for roads built under different conditions are shown. Probably the best information touching upon this most important aspect of rural development can be found within the leaves of this pamphlet, since each section was revised or edited by the experts in the various divisions of the Office of Public Roads and Rural Engineering.

Canadian Mineral Production

Bulletins on Canadian production of (1) "Coal and Coke," (2) "Cement, Lime, Clay Products, Stone and Other Structural Materials," (3) "Copper, Gold, Lead," etc., for 1916 and a preliminary report on "Mineral Production of Canada" for 1916 have been issued by the Department of Mines, Ottawa, Canada.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

BUILDING AND ORNAMENTAL STONES OF CANADA: Vol. IV, Manitoba, Saskatchewan and Alberta.—By William A. Parks. Ottawa, Ont.: Canada Department of Mines. Paper; 6 x 9 in.; pp. 323; halftone and colored plates, maps and drawings.

Three earlier volumes dealt with the general technology of stone and quarries and described the stones of the eastern provinces of Canada.

BUILDING ZONES: A Handbook of Restrictions on the Height, Area and Use of Buildings, with Especial Reference to New York City.—By George B. Ford, Consultant to the Commission of Building Districts and Restrictions, assisted by Herbert S. Swan and F. P. Schiavone. New York: Record and Guide Publishing Co. (for Lawyers Mortgage Co.; address the first-named company.) Paper; 9 x 14 in.; pp. 36; 16 colored maps and numerous diagrams. $1.

Reprint of building-zone resolution adopted July 25, 1916, by Board of Estimate and Apportionment, New York City, with explanatory diagrams and maps. Mr. Swan contributes a digest of state and Federal decisions bearing on the constitutionality of such regulations. There is also a helpful section on general principles and methods governing the creation of building restrictions and zones.

COMPRESSED AIR: Theory and Computations.—By Elmo G. Harris, M. Am. Soc. C. E., Professor of Civil Engineering, Missouri School of Mines, in charge of Compressed Air and Hydraulics. Second edition, revised and enlarged. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 192; illustrations and many tables. $2.

In the present edition a chapter on centrifugal fans and turbine compressors has been added; also several appendices, including one on the design of logarithmic charts. The latter, it is claimed, is new to textbooks. The volume is essentially mathematical, "for college-bred men." The first edition was noted in "Engineering News," Jan. 19, 1911.

CONNECTICUT PUBLIC UTILITIES COMMISSION: Report for 1915-16.—Hartford: The Commission. Cloth; 6 x 9 in.; pp. 659.

DESIGN OF OUTLET SEWERS AND SEWER OUTLETS: Rules Formulated by Board of Consulting Engineers and Adopted by Board of Estimate and Apportionment, New York City.—Paper; 5 x 10 in.; pp. 11; map and diagram showing standard datum planes.

HEALTH SURVEY OF NEW HAVEN, CONN.: Documents of the Civic Federation of New Haven, No. 17. Report by C.-E. A. Winslow, James C. Greenway and D. Greenberg, Yale School of Medicine. New Haven: Yale University Press. Paper; pp. 114; illustrated. 50 cents.

An excellent study under the direction of Professor Winslow, with sections on water-supply, sewage and garbage disposal, but concerned chiefly with the health department and housing.

INSTRUCTIONS AND INFORMATION FOR EMPLOYEES.—Greenville, Mass.: Issued by Greenfield Tap and Die Corporation. Paper; 5 x 7 in.; pp. 32.

Some of these rules and suggestions would probably be useful to other manufacturing corporations.

INVESTIGATIONS OF THE ECONOMICAL DUTY OF WATER FOR ALFALFA IN SACRAMENTO VALLEY, CALIF., 1910-1915.—By Coöperative Irrigation Investigations in California. Berkeley, Calif.: Agricultural Experiment Department, University of California. Paper; 6 x 9 in.; pp. 78; illustrated.

IRRIGATION WORKS CONDUCTED BY THE UNITED STATES GOVERNMENT.—By Arthur Powell Davis, Chief Engineer, United States Reclamation Service. New York: John Wiley & Sons. Cloth; 6 x 9 in.; pp. 413; 128 illustrations. $4.50.

LIGHTHOUSES AND LIGHTSHIPS OF THE UNITED STATES.—By George R. Putnam. New York: Houghton Mifflin Co. Cloth; 6 x 9 in.; pp. 294; illustrated. $2 net.

MAINE PUBLIC UTILITIES COMMISSION: Report for 1915-16.—Augusta: The Commission. Cloth; 6 x 9 in.; pp. 590.

MANITOBA PUBLIC UTILITIES COMMISSION: Report for 1915-16. Winnipeg, Man.: The Commission. Paper; 6 x 9 in.; pp. 160; maps and diagrams.

MASSACHUSETTS STATE DEPARTMENT OF HEALTH: Report for 1914-15. Boston: The Department. Cloth; 6 x 9 in.; pp. 826; illustrated.

MECHANICAL EQUIPMENT OF BUILDINGS: A Reference Book for Engineers and Architects.—By Louis A. Harding, M. Am. Soc. M. E., Chief Engineer John W. Cowper & Co., Buffalo, N. Y., and Arthur C. Willard, Assistant Professor of Heating and Ventilation, University of Illinois. Vol. II, Power Plants and Refrigeration. New York: John Wiley & Sons. Flexible binding; 7 x 10 in.; pp. 757; illustrated. $5.

MILK AND ITS HYGIENIC RELATIONS.—By Janet E. Lane-Clayton, M.D., D.Sc., Assistant Medical Inspector under the Local Government Board. Published under the Direction of the Medical Research Committee (National Health Insurance). New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 356; 8 plates. $2.50 net.

Very comprehensive, but almost wholly from the viewpoint of private rather than public hygiene.

MUNICIPAL OWNERSHIP: A Brief Survey of the Extent, Rapid Growth and the Success of Municipal Ownership Throughout the World, Presenting the Arguments Against Private Ownership, the Failure of Regulation and the Advantages of Municipal Ownership.—By Carl D. Thompson. New York: B. W. Huebsch. Cloth; 5 x 8 in.; pp. 114; $1 net.

ON THE NATURE OF COLOR IN WATER.—By Thorndike Saville, Assistant in Municipal Administration, Harvard University, Cambridge, Mass. Reprinted from "Journal" of New England Water-Works Association, Vol. XXXI, No. 1. Address the author. Paper; 6 x 9 in.; pp. 123; illustrated.

ONTARIO BOARD OF HEALTH: Report for 1915—Toronto, Ont.: The Board. Paper; 7 x 10 in.; pp. 166; illustrated.

RAILWAY ESTIMATES DESIGN QUANTITIES AND COSTS.—By F. Lavis, M. Am. Soc. C. E., Special Lecturer Railway Engineering, Yale University. First edition. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 608; 99 illustrations and folding plates. $5.

THE SALTON SEA: An Account of Harriman's Fight with the Colorado River.—By George Kennan. Cloth; 6 x 8 in.; pp. 106; illustrated. $1.

TOWN PLANNING FOR SMALL COMMUNITIES.—By Walpole (Mass.) Town Planning Committee, Charles S. Bird, Jr., Chairman. New York and London: D. Appleton & Co. [National Municipal League Series.]. Cloth; 5 x 8 in.; pp. 509; illustrated. $2 net.

More than half of the book deals with the general subject stated by the title. The remainder is a committee report on planning for Walpole, Mass., a small but growing industrial community. The work is highly commendable, especially from the local viewpoint, but for most readers outside of Walpole, and probably in Walpole as well, it would have been more useful if materially condensed.

SANITATION PRACTICALLY APPLIED.—By Harold Bacon Wood, M.D., Dr. P.H., Assistant Commissioner, West Virginia State Department of Health; formerly Director Mississippi State Board of Health Laboratory, Whole-Time Health Officer, Rochester, Minn., and Topeka, Kan. Cloth; 6 x 8 in.; pp. 473; illustrated. $3 net.

SPRAY IRRIGATION: Tests of the Distribution of Water by Various Plants.—By George H. Tolley, Irrigation Engineer. Sydney, New South Wales: Water Conservation and Irrigation Commission. Paper; 6 x 9 in.; pp. 32; illustrated.

Summaries of tests made in 1916 of various spraying-device installations at the Experiment Farm of Emu Plains, 40 miles from Sydney. Most of the space is used to describe the spray systems tested.

WARSHIPS: A Textbook on the Construction, Protection, Stability, Turning, etc., of War Vessels.—By Edward L. Attwood, M. Inst. N. A., Member of the Royal Corps of Naval Constructors; Author of "A Textbook of Theoretical Naval Architecture," "The Modern Warship"; Joint Author of "Laying Off," a Textbook on the Geometry of Shipbuilding. Sixth edition. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 338; illustrated; $4 net.

The first edition of this book was noticed at length and favorably in "Engineering News" of Dec. 15, 1904, by Prof. Amasa Trowbridge. Since then it has passed through a number of editions or printings and been translated into Spanish. In the present, or sixth, edition "a considerable number of modifications" have been made "in consequence of the rapid change of practice in recent years."

WATER RESOURCES OF THE STATE OF OREGON: Summary of Available Information.—Compiled and prepared under the direction of John H. Lewis, State Engineer, in coöperation with the United States Geological Survey, George Otis Smith, Director. Bulletin No. 4. Salem, Ore.: Office of State Engineer. Paper; 6 x 9 in.; pp. 353.

Publication in this compact form should be of material assistance in promoting water-power and irrigation development.

WATER RIGHTS BRANCH, DEPARTMENT OF LANDS, BRITISH COLUMBIA: Report for 1916.—Paper; 7 x 10 in.; pp. 48; illustrated.

Deals chiefly with irrigation. Contains rainfall and water-power statistics.

WEST VIRGINIA STATE BOARD OF HEALTH: Report for July 1, 1914, and June 30, 1916. Wheeling, W. Va.: The Board. Cloth; 6 x 9 in.; pp. 304; illustrated.

Chlorination and Chloramine

Addition of Ammonia to Hypochlorite Reduces Water Chlorination Cost—Author's Abstract of Paper Before American Water-Works Association, May, 1917

By JOSEPH RACE
City Bacteriologist, Ottawa, Ont.

THE addition of ammonia to bleach and sodium hypochlorite solution very markedly increases the germicidal velocity, but similar mixtures with solutions of chlorine gas are contraindicated. The experiments with ammonia led to a trial with this substance on a plant treating 200,000 Imp. gal. per day; and after the preliminary difficulties had been overcome, equally good results were obtained with the use of 0.25 p. p. m. of chlorine and 0.12 p. p. m. of ammonia as had previously been secured with 0.90 p. p. m. of chlorine in the form of bleach.

To Prevent Excess of Ammonia

These experiments showed that the important factor in securing results is to prevent the presence of a local excess of concentrated ammonia. When concentrated ammonia was added to the 0.5% solution of bleach, inferior results were obtained. This was due to the formation of nitrogen gas and ammonium chloride, which have no germicidal action, together with a small amount of hydrazine. The best results were secured by diluting the ammonia in separate vessels until the solution contained 0.3 to 0.4% of anhydrous ammonia and discharging this solution through an orifice in the usual way into the hypochlorite discharge pipe just before its point of entry into the suction of the pump. The cost of materials on this experimental plant was reduced approximately 50% by the ammonia or chloramine process.

In 1917 this method was applied to the main plant, where 20,000,000 Imp. gal. per day are treated without filtration or other preliminary purification. The results from this plant confirm those from the experimental plant. At one period during the spring floods the B. coli content of the raw water was reduced from over 500 to 2.5 per 100 c.c. by means of 0.6 p. p. m. of Cl and 0.12 p. p. m. of NH_3 when the color was 40 p. p. m. and the turbidity 80 p. p. m.

Chloramine Process at Hull

The City of Hull, Que., treating the same water with liquid chlorine, reduced the B. coli index to 26.7 per 100 c.c. by the use of 0.7 p. p. m. of available chlorine. With waters such as the Ottawa River, which contain considerable amounts of organic matter, the chloramine process is more economical than either liquid chlorine or straight bleach; and the reduced chlorine dosage has eliminated any danger of odors and tastes that were occasionally observed.

The action of the ammonia is to produce a chlorine derivative of ammonia known as chloramine (NH_2Cl), which has been shown by Rideal to have a carbolic coefficient of 6.6 as against 2.2 for chlorine. Chloramine has no oxidizing effect, and the fact that the addition of ammonia to bleach destroys the oxidizing action and enhances the germicidal action has led to a reconsideration of the usual hypothesis that the germicidal action of chlorine and its compounds is due to the production of nascent oxygen. Figures are given which show that the germicidal action of chlorine is at least five times greater than its oxygen equivalent, and a hypothesis is suggested that the germicidal action of chlorine is a straight toxic one on the organisms. In most cases the greater part of the chlorine is used up in the oxidation of the organic matter, and it is by preventing this action that ammonia increases the germicidal action of hypochlorites.

Ore Dock Has 384 Electric Hoists

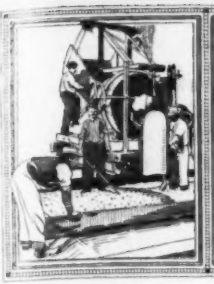
Individual electric hoists with 25-hp. motors are used to handle the hinged spouts of the new ore dock (No. 5) of the Duluth, Missabe & Northern Ry. at Duluth, Minn. The accompanying view shows the row of hoists along

DOCK WITH 384 ELECTRIC HOISTS

one side of the dock. At the left are the tracks over the open tops of the 350-ton bins or pockets, and on the other side of the dock is another row of hoists. The steel masts carry crosswires from which electric lights are suspended. These hoists were built by the Clyde Iron Works, of Duluth, Minn., which has supplied similar outfits for other new ore docks.

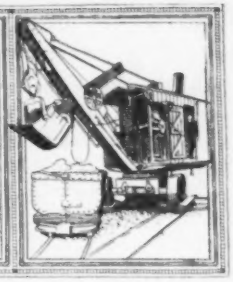
Panama Canal Business

The total number of ships making the transit of the Panama Canal during April was 159. The aggregate net tonnage of the ships passing through the Canal during the month was 551,471, Panama Canal measurement, and the total cargo carried through the Canal was 627,705 tons of 2240 lb. Collections of tolls amounted to $514,050.44, and deposits were made with assistant treasurers in the United States in the amount of $248,183 to be applied on payment of tolls and other charges against vessels using the Canal.



HINTS FOR THE CONTRACTOR

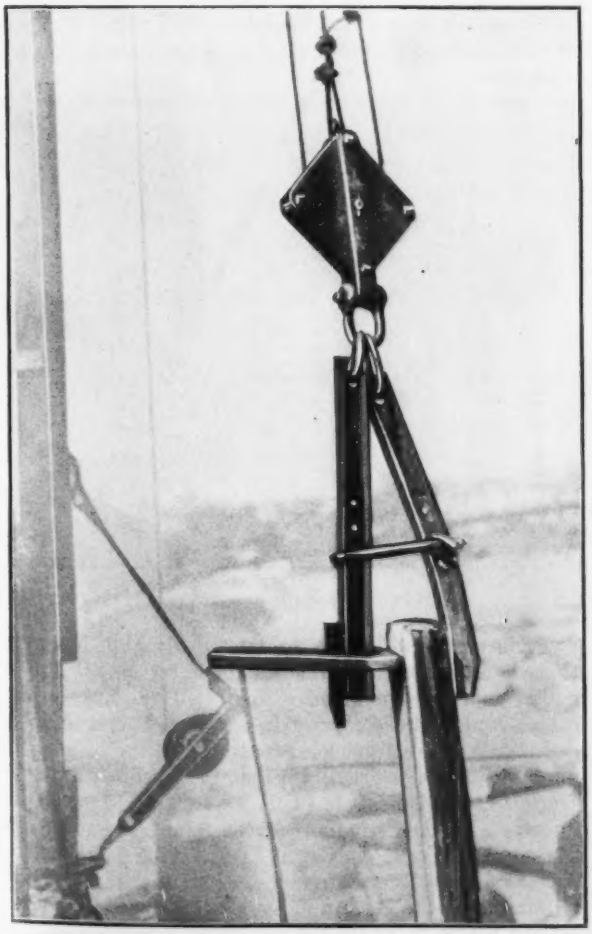
DETAILS WHICH SAVE TIME AND
LABOR ON CONSTRUCTION WORK



Puller for Wood Sheet Piles Is Made Up of Old Material on the Job

By LEWIS B. WYCKOFF
Assistant Superintendent, Suburban Engineering Co.,
New York City

IN A sewage-disposal plant under construction at Greenwich, Conn., the contractor wished to pull some wood sheet piling 4 x 10 in. in section and 20 ft. long. All derricks capable of taking the necessary strain had by that time been moved off the work, so a light A-frame of 6 x 6-in. timbers was put together and braced by trussing the vertical legs. Pulling from this frame, the ordinary pile tongs bent under the strain and failed to move the pile. It was impossible to get steel from the job to make a heavier pair of tongs, so the contractor set to work to build a special set of grips from old material.



WOODEN PILE PLATE MAKES PILE-PULLING JAW

Two pieces of light-section rail were joined by links at the upper end and provided with a third link slipping over the two pieces and prevented from rising on the two by lugs set into the rail. The bottom of one of the rails was then drawn round to form a hook on its flange side, and on the other rail a wooden pile plate was fastened by passing the rail through a hole in the plate and fastening a bolt below the plate to prevent it from dropping off. Wedges were then made to take up the slack between the rail and the hole in the plate when the plate took bearing against the pile to be pulled.

When the puller was placed over the top of the pile, the plate stood at an angle of about 45° at the back end. The plate was then raised until the teeth in its front end jammed into the wood; then as the strain was taken on the lifting line, the teeth would jam harder and the hook at the end of the opposite rail would also dig into the pile. The wedge was then dropped into the hole behind the rail, making the whole rig fast. The grip held tight under any strain that the engine was able to give.

The rig worked perfectly; but in starting the first pile, additional lifting power had to be given by a long lever and by stirring up the ground around the pile with water jets.

Convert Team Outfit Into Tractor-Trailer Equipment Where Horses Are Scarce

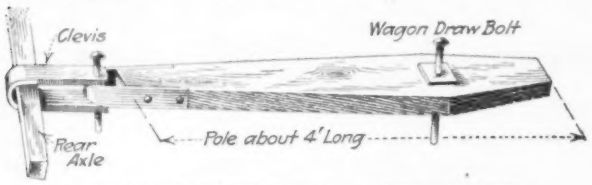
By L. R. BARNES
Of Chambers & Barnes, Contractors, Rochester, N. Y.

A SIMPLE and economical method of hauling stone or gravel in common 1½-yd. dump wagons has been used by Chambers & Barnes on state-road work in localities where teams are scarce and their use expensive. The wagons are hauled in trains with a common steam roller or light tractor.

The equipment required consists of the 10-ton roller or tractor mentioned, from 12 to 18 common dump wagons, each with a 4-ft. pole and clevis, such as is shown in the sketch, and from two to three teams with two handy laborers, one stationed at the source of supply and the other at the dumping end. The grades to be hauled over should not exceed 5%, and the hauling distance may range from 2 to 4 miles.

If gravel is being supplied from a pit, the start may be made by placing two empty wagons ready for loading. A team then hauls the first load out and spots it at a near-by convenient place on the roadside. The teamster, with the assistance of the handy man, then pulls the drawbolt, uncouples the pole and uses it to haul an empty wagon into the pit to spot for loading. Using the same pole again, the teamster hitches his team to the second loaded wagon, draws it directly behind the first and leaves it as close as possible to the latter. As each successive

load is brought up, it will be found that, if a good driver is employed, he can drive the team in such a manner that the wagon pole between the horses may be used to push against the backboards of the loaded wagon ahead, thus shoving it close enough in the train so that the short pole



COUPLING CONVERTS WAGON INTO TRAILER

coupling may be made. This is done simply by making fast the end of each pole to the clevis attached to the rear axle on the wagon ahead.

By adjusting to the conditions the number of men loading and the number of wagons in each train, one tractor can handle three trains, so that while one is being loaded and made up at the pit, the second will be on the way, either loaded or empty, and the third will be in process of dumping. The trains are of course dumped in the inverse order to that in which they are loaded. Usually, unloading will take fully as long as loading, because it is not often possible to approach with a tractor and train nearer than 500 to 1000 ft. of the finished grade where materials are to be deposited.

It will be found that a good man to assist each driver in coupling and uncoupling the wagons will greatly facilitate the work. On a 2-mile haul, when the work is handled in this way, a roller or tractor will replace four or five teams.

Contractor Finds Many Uses for Models of Complicated Concrete Piers

MODELS for the piers for the new Franklin-Orleans St. bridge over the Chicago River have been made by the contractor for the substructure in order to show clearly to the fieldmen the general form and details of construction, which are not readily apparent from the drawings. The Great Lakes Dredge and Dock Co., of Chicago, has the contract for this work. The models shown in the view were suggested and planned by J. E. Cahill, engineer of the company, and were made by A. Cederoth, chief draftsman.

The structures are unsymmetrically shaped boxes of reinforced concrete, supported on concrete cylinder piers sunk to rock at a depth of about 106 ft. The north pier is about 90 x 80 ft., and the south pier about 80 x 34 ft. Owing to the existence of tunnels, one corner of the south pier has to be left without direct support from beneath and is carried therefore by a heavy steel cantilever truss embedded in the front wall, as indicated by dotted lines. On an enlarged photograph of the models the tunnels are drawn, and various dimensions and elevations are marked. This photograph, 30 x 40 in., is practically an isometric view on a scale of about ¼ in. to the foot.

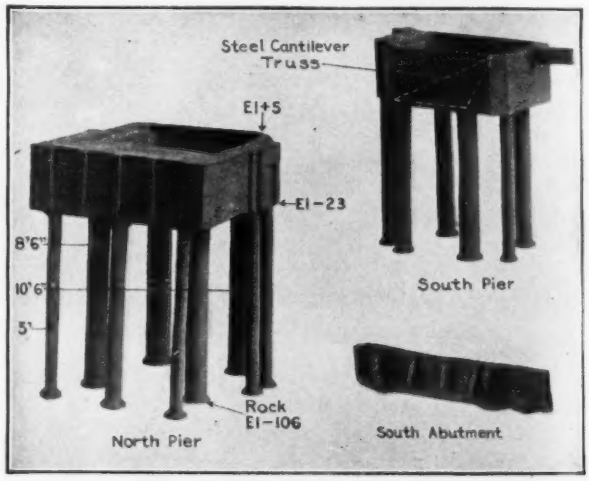
The models are on a scale of 20 ft. to the inch. This is the same scale as the general plan of the bridge, so that by placing the models on the plan the relative positions of the wells, piers and adjacent structures are readily shown. The models of the piers were made from old cigar boxes and heavy pasteboard. The shafts are of wood, turned in a lathe to proper size, with a bead to show the belling at the bottom of the shafts. The south land abutment was modeled in clay, owing to the intricacies of its construction. This abutment will be carried by 112 piles. The hole in the bottom, at the right, represents a 7-ft. sewer.

These models illustrate the outside lines of the concrete and the general idea to be followed out in building forms, placing reinforcement and pouring concrete. They serve also to impress upon the men in charge of the sinking the relative sizes and positions of the piers. In addition to the primary purpose already noted, other ideas have followed, and the men in the office are using these models for such purposes as laying out cofferdam plans and working up progress charts.

The primary idea of the models is the more important, especially impressing upon the carpenters and form builders such matters as the form and number of counterforts in walls and also the shape and details, as well as the relative elevations and lines, on all the concrete work. Thus, the study of models by the form carpenters may easily result in avoiding mistakes that are apt to occur in building forms for complicated concrete structures or detail parts.

On account of the south pier being intersected by two large tunnels of the Illinois Tunnel Co., the study of the model of this pier has solved questions arising in the minds of the foremen and others.

The models have served more than the purpose that was in view when they were made. It is the opinion that the



MODELS HELP FIELD FORCE BUILD CONCRETE PIERS

planning of work for this bridge substructure has been covered, on account of the use of these models, in a more comprehensive manner than that for any of the bridges which the company has constructed; and it is proposed to use such models extensively in the future. It is interesting to mention also that these models are constructed to the same scale (1 in. = 20 ft.) as that of the company's models of its working plant, described in *Engineering News*, July 29, 1915. This fact enables models of derricks, piledrivers, etc., to be laid alongside the models of the structure, showing their relative sizes and the extent to which the navigable channel would be obstructed by the plant.

EDITORIALS

War Not To Stop Public Improvements

EVIDENTLY, municipal improvements are in no immediate danger of being stopped on account of panic on the part of the taxpayer. The public-works engineers who are reporting on the present attitude toward municipal improvements say that almost as much will be done this year as last. In most cases petitions for new work are as numerous and insistent as last year. The chief cause for postponing work brought out by the inquiry is the continuing rise in the cost of materials, which has been sufficient in some cases between the time of making assessments or appropriations and the time of letting contracts to make it impossible to carry out projects for the sums contemplated. The fact that the banking resources of the country have been little affected by the war loan will mean that cities, like other corporations, should have no extraordinary difficulty in financing work, while the prosperous condition of the average citizen resulting from the conditions of the past two years would indicate no necessity for curtailing taxes as yet to such an extent as to shut off necessary and beneficial improvement work.

Good Structures Can Be Built of Timber

TIMBER construction has acquired a new popularity as steel and cement prices have mounted to higher and higher levels and delivery-times became more and more discouraging. The 150-ft. redwood braced arch shown on our opening page marks this new era of timber very distinctively. It will be well for engineers to face the certainty that cost and delivery arguments will continue to favor timber for some time to come. Just now events are placing particular emphasis on the abnormality of conditions—when two government factions quarrel whether $60 or $95 per ton is the right price for ship plate, while the market for private buyers is much higher. And it ought to be clearly remembered, at the same time, that wood is a highly efficient and adaptable structural material. The days of Howe-truss railway bridges are gone, perhaps, but they gave proof that a wide range of conditions could be met by timber, and that good, long-enduring structures could be built. The Rock Creek arch portrays one of the modern possibilities.

Bridge-Building Changes Should Be Recorded

OF THE many elements of change in bridge design, few are recognized by the majority of engineers until after some marked development has made the process of change quite apparent. The truth is that change is so gradual, so unobtrusive, that only those designers who keep in closest touch with both broad and detail phases of bridgework are able to observe and interpret the tendencies. The comments of one such engineer, given in last week's issue, are therefore as unusual as they are helpful—helpful to the younger bridge engineers, at least, if not to the mature men of the profession. While the article carried its message clearly enough, we would emphasize the broad fact that the entire article was pervaded with the atmosphere of change, of evolution. So much of the current thought in the bridge and structural field seems to base on a conception of finished development—almost of stagnation—that this atmosphere has a decidedly refreshing effect. There is evidently more to be said of the direction of coming progress in bridges. With the active help of its bridge-building readers, *Engineering News-Record* hopes to record many of these further observations.

Pavement Foundations a Matter of Judgment

ENGINEERING questions which elude strict mathematical treatment, demanding instead the employment of judgment, are always provocative of discussion. Into this category fall most of the problems connected with paving, for here the combination of destructive factors is neither known nor stable and is generally disturbed by many uncertainties as to the manner in which permanency is conditioned. Inevitably, the paving engineer must fall back upon an intuition which should rest on years of experience and be vigorously cleared even of the prejudices which are bred of success. And of all paving, the problem of the foundation is the most basic and elusive—for failure, manifesting itself solely at the surface, may have an origin quite removed and unconnected. This requires of the engineer a balance of judgment which cannot be too fine, lest combinations be overlooked, nor too coarse, for the fault may reside in purely local differences. The caution with which Lester Kirschbraun approaches the subject of foundations for sheet asphalt pavements in an article in this issue is a tacit acknowledgement of this fact.

An Engineer Stands Up for His Profession

A SIX-FOOT dike in California, built over 50 years ago by miners, was carried out during the high water of two weeks ago. The water loss was unimportant, and little or no damage was done. But a San Francisco daily promptly came out with an editorial which made the "Echo Lake dam failure" the basis of deprecatory insinuations against the reliability of engineers and contractors. Without going into the origin, kind or importance of the dike, the editorial moralized on the inexcusableness of poorly designed, inadequate structures, and, to say the least, left room for the thought that modern engineering skill has been weighed and found wanting. A San Francisco civil engineer promptly addressed a letter to the editor of the daily, stating the facts of the case and showing that the washout does not reflect on engineers or contractors or on supervisory public officials. He could not undo the bad effect of the original publication, but he

could and did lessen the chance of future publications of the same kind. The interest of *Engineering News-Record* in the story is that it provides a good example of how the individual engineer, single-handed, can help the profession forward by clearing up a situation whose false report reflects disadvantageously on engineering work. This is a class of service that is within the power of every engineer. If each of us were as alert and energetic as our San Francisco brother the profession would be the gainer.

Electric Locomotives Not Unduly Costly To Maintain

COST DATA—absolute and comparative—are as necessary to engineers as food. Whenever, therefore, the technical journal finds any in so unimpeachable a document as the official report of a railroad, it is tempted to annex them without delay. *Engineering News-Record* is well aware that correct figures may induce wrong conclusions—in spite of which an instance of this sort recently slipped by the editorial scrutiny. In the issue of Apr. 19, page 131, was a note showing that electric locomotives on the Norfolk & Western Ry. for the six months ended Dec. 31, 1916, cost more than twice as much to maintain as steam. The numerous figures presented were taken from the company's official report, and are correct. But any conclusion therefrom that the electrification of the 30-mile section of this line is making a bad showing is unwarranted. Proper exception has been taken to the note, and the suggestions that follow were obtained from a motive-power official of the company.

In the first place, the electric locomotives have a far greater hauling capacity than any of the steam locomotives. The electric engine hauls a 50% heavier train than the largest Mallet, and this on the steepest grade on the road and on a section where the largest amount of shifting by main-line power is necessary. Comparison, therefore, between the maintenance costs of the electric locomotives on this 30-mile mountain section and the costs of the steam equipment of the entire road is misleading, nor is it much less so if we consider only the 110-mile division of which the 30-mile electrified zone is a part, or make comparison with the light steam engines that operate in the electrified zone.

Another point having much bearing on the matter is the fact that the maintenance figures for the electric equipment include a great expense attendant upon the development and maintenance of service with a new type of locomotive, the heaviest in capacity that has ever been put into everyday service. The engines have been handling the tonnage contracted for, and no effort has been made to relieve them in any kind of weather. It is believed that the maintenance costs will gradually decrease as the entire engine becomes standardized and operates under uniform conditions.

The opinion is expressed that it will be several years before conclusive figures will be obtainable comparing steam and electric operation on the Norfolk & Western. Meanwhile, its electric locomotives are doing their work, and there is no thought on the part of those in charge of them that they are not doing it economically.

Scientific Spirit Needed for Engineering Work

TWO simple rules given by R. E. Horton in our pages a few weeks ago are worth fuller comment than he gave them, because of their broad application to many parts of engineering work. Mr. Horton offered them as rules for certain kinds of hydrological work. Really, however, they hold good for all empirical investigations. They are two principles of correct observation, or perhaps of correct deduction from observation. It will be worth while for every reader to re-read them and test their application to those empirical problems that he meets in his own work.

Nearly every empirical or statistical study involves a maze of variables, and in the early study there may appear to be no hope of tracing out general laws. But experience shows that by getting together small groups of data, each group extending over a small range of the variable, indications of the underlying laws may be discovered at an early stage; and then, if used only so far as the basic data allow, they will supply a valuable guide to direct the further studies. But it is vitally important here, as well as in tracing out the first indications of laws from the earliest data, to include with absolute impartiality all the data to hand, and then limit the result to but little beyond the range of these data, just as Mr. Horton says. By such procedure, far-reaching results can be obtained in a surprisingly large number of cases.

Now, the process described may be summarized in the two terms diligence and fairness: Patient diligence in finding and putting together data, and strict fairness in using them and applying the results. All easy temptation to reject inconvenient data must be resisted, and yet, taking common sense as a factor in the calculation, those results which are incompatible with any explanation must be put aside. Empirical studies in this way put the investigator's conscience to a fine test. We get down to the true scientific spirit, a compound of keen insight and steady love of truth.

The fact is that engineering investigations are apt to be problems for scientific research, and not tasks to be handled by some easy handbook rule or diagram.

Wanted—An Up-To-Date Library of Engineering Patents

THERE is a real need for a complete reference library of American patents relating to engineering and construction. Unsuspected patents on reinforced concrete, roads and pavements, water-supply, and construction equipment constantly make serious trouble after belated discovery. Such interference could be eliminated by a little search, if only the references were available. There is but one public library in the country (at the Patent Office in Washington) where all the American patents issued have been classified for quick access. But this library is already out of condition through governmental parsimony.

Here is a chance for the Engineering Foundation, established two years ago by Ambrose Swasey, of Cleveland, to undertake work for the benefit of the profession. We

propose that this endowment should establish as soon as possible—at present it is temporarily supporting the National Research Council—within the National Engineering Societies' library in New York City a complete reference file of all United States patents relating to engineering. Such a library would require expert service, but it could be made self-supporting through work done for men unable to come in person. One result, in itself not unimportant, would be the stimulation of interest by engineers in the American patent system; pressure might be exerted on Congress to eliminate the abuses of the existing situation and to give the Patent Office sufficient appropriations to handle its work. Here is a rare opportunity open to an institution founded for real service.

Government and Railways Must Coöperate To Improve Rails

THE Interstate Commerce Commission's report on the Iser wreck, containing important facts on rail defects, was made public in advance of the recent meeting of the American Railway Engineering Association, whose weightiest subject of discussion was the improvement of defective steel rails. Yet the Iser report received no attention whatever at the meeting, although, as shown by the review in the May 31 issue of *Engineering News-Record*, it had very pertinent bearing on the matters there discussed.

The Association is officially charged by the railways with studying rails and their improvement, and thus the public's safety depends quite directly on what the Association does. It is natural and necessary, then, that the Association should study and discuss the Iser report. The fact that at its meeting it did not do so seems a neglect of opportunity, not to say of duty. Quite possibly this seeming neglect will be made up by committee study, which after all is the Association's best method of working; yet the present loss of opportunity leads to delay and to reduced energy of action.

Coöperation between government and railways is not only increasingly necessary, but is being secured in greater extent from day to day. This applies to cooperation between administrative departments; should it not also apply to coöperation between the proper government bureaus and technical railway associations?

There is even now a certain amount of this coöperation in technical problems, many of which are taken up in joint study by the government and individual railways and mills. The safety division of the Interstate Commerce Commission, for example, has been able to do its rail investigation work only through the active assistance of steel plants and railway engineers. In like manner ought the railway associations work hand in hand with the government's technical forces. United effort is sure to bring quicker and better results than separated work.

Were the preceding remarks not obvious in themselves they would be illustrated and emphasized by the discordant nature of the rail discussion presented at the meeting of the American Railway Engineering Association. The opinions and assertions expressed represent a large amount of confusing contradiction and a very small amount of results. Perhaps this confusion is merely the chaos out of which order will come, the last stage before the drawing of final and sound conclusions. Nevertheless, there are no present grounds for believing that the association can dispense with any assistance or coöperative counsel that may be available. It cannot afford to ignore helpful work done by a reputable government bureau.

Use of Models on Construction Work Suggests Wide Field

SOMETHING new in the use of models of engineering structures is recorded in this issue and suggests a rather wide field for development. So far, models of this kind have been mainly of a pictorial character, showing the design and appearance of complete structures (built or proposed) or special details of design. But in the case noted above the models were made by a contractor for the assistance of the foremen and others engaged in planning for the construction of a large and costly piece of work.

It is very necessary that the men engaged on such construction and perhaps especially those who have to build forms for concrete work, who may be compared to patternmakers on machine work, should visualize, or see "in their mind's eye," the shape and outline of the solid structure as it is to be. It is true that they can read plans, but with structures of irregular or peculiar shape it is often difficult for a foreman or a workman to grasp the idea from plane and sectional plans alone. The study of plans in order to comprehend them takes time, and many matters obscurely indicated may be overlooked or misunderstood.

Isometric and perspective drawings have been employed to advantage in such cases. But the model that a man can handle and turn over to examine in various aspects enables him to see at once the structure as a whole, with the form and relative positions of its several parts. He sees the thing itself in miniature and not merely a drawing or picture that can show him only one aspect. With this idea of the structure in his mind, the use of the working plans becomes an easy matter, because he knows and has seen what they represent.

The practical value in this respect is illustrated by the specific case described elsewhere, for it is stated that examination of the model enabled the foremen to see their way out of certain threatening difficulties in the work. In fact, so useful has it proved that the firm has practically decided upon a rather extensive use of models in future work.

While the main advantage may be for the construction forces, there are other lines of usefulness for the model —to the office men, the engineer, the designer and the draftsman. For instance, it is easily conceivable that study of a model may greatly facilitate working out detail drawings or enable difficulties and improvements to be foreseen and desirable modifications planned. One very interesting prospective use of models is in the way of forming progress records, as described in the article already mentioned. For this purpose the idea is as interesting and promising to the engineer as to the contractor.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors will be Welcomed

Organize Engineering Council on a Broad Basis

Sir—C. E. Drayer's letter on the Engineering Council, in your issue of May 3, 1917, p. 877, is the opening gun in a discussion that I hope will continue in your columns until some comprehensive plan along lines commensurate with the important work which is before the various branches of the engineering profession in this country shall be devised and put into execution. Instead of a divided front to the world and a divided allegiance to our various societies, there must be one grand organization to which we can all contribute our support and look for advice, and which can speak with no uncertain voice in matters that concern the interests of engineers at large, or through which our united services can best be furnished to the nation.

In the first place, such an organization to conform to our democratic ideals must include in its membership directly or by adequate representation practically every engineer in the country. There are still a vast number of engineers who are not affiliated with any society and whose interest and coöperation it will be necessary to win and retain. This can only be done by taking into account two facts: One, that the engineer is not an animated instrument of precision, but a human being with social instincts; the other, that the professional interest of the average engineer begins, even if it does not end, at home. Any plan, therefore, which promotes at the same time sociability and engineering interest in local matters is more likely to result in a live, red-blooded institution commanding the pride and hearty support of its members than one in which these factors are not so prominent.

ROBERT W. ADAMS,
Vice President, Providence Engineering Society.
29 Waterman St., Providence, R. I.

Car-Mounted Coast-Defense Guns Suggested Years Ago

Sir—I have just perused the May 31 issue of *Engineering News-Record*, and note, on p. 469, the letter of F. W. Harris about car-mounted guns as a means of coast defense. He says he suggested this scheme in 1910.

I have a volume of "Stories by American Authors," published by Charles Scribner's Sons in 1891 and copyrighted by the same publishers in 1884. I presume the stories were originally published in *Scribner's Magazine* in the latter year. One of the stories in this volume is in the nature of a war prophecy by one Park Benjamin; it is entitled "The End of New York." In this story, a Spanish fleet attacks New York City. I quote as follows from Mr. Benjamin's account of one of the plans for defense of the harbor:

"General Newton proposed the building of continuous earthworks on both shores of the bay and Narrows, behind which a broad-gage railroad should be constructed. On the track he placed heavy platform-cars, each car carrying one heavy gun. Embrasures were made at regular intervals along the embankment. His idea was, that if a hostile vessel made her way into the harbor, the gun-cars should move along behind the earthworks, keeping abreast of the ship, and thus pour into her a continuous fire. Measures were promptly taken to follow this plan."

R. R. POTTER.
Allegan, Mich.

The Case of the Standley Lake Dam

Sir—"The Case of the Standley Lake Dam," discussed in *Engineering News-Record* of May 31, p. 440, brings to mind the case of a slip of identical characteristics which occurred in the Coal Ridge Cut, a cut about a mile long and some 20 ft. deep, which was made for the Coal Ridge Ditch, west of Fort Lupton, Colo. The material excavated showed a sandy-loam topsoil about 12

SLIP AT COAL RIDGE CUT

or 14 ft. in thickness, underlain with a stratum of blue clay. This clay was very hard and tough when dry, but absorbed water readily, and when wet became very greasy and slippery.

After water had been turned through the cut for a few days, a small crack developed well up on the sand-loam slope and running for several hundred feet approximately parallel with the center of the cut. This crack gradually widened until it became about 10 in. Then the mass below the crack dropped vertically downward in an upright position, leaving the material above the crack in a nearly vertical declivity several feet high, and the bottom of the ditch buckled upward to a height of about 2 ft. At the bottom of the crack a well-defined fault plane could be seen, which was as smooth as if cut with a knife and which had a slope of about five to one.

Mr. Hays states that the bottom lifts of the Standley Lake dam were composed of this blue-clay material, and to this fact the writer attributes the cause of the slip.

It would seem probable that the initial slip on the outer slope, which occurred in 1912 or a year after the completion of the earthwork, was occasioned by the dry-

ing out of the puddled clay interior of the dam, from a flowing consistency to that firmer consistency at which it would slip on a well-defined plane.

The main slip on the inner face occurred in 1916 after the reservoir had been filled, or nearly filled, for several consecutive seasons, and was probably caused by a resaturation from water in the reservoir.

Inasmuch as shrinkage had no part in the Coal Ridge slip, the writer would argue that the shrinkage in the dam could hardly constitute an important contributing factor of the slide and that the presence of the rock riprap had no material effect one way or the other.

It would seem, however, that the existence of the trestles in the embankment would have a tendency at least to resist sliding on a plane that would pass through the bents, and be consequently helpful rather than harmful.

The problem of overcoming these slides will be one of interest to Western engineers, particularly in localities where it is difficult to avoid the use of the blue-clay material.

R. W. GELDER,
Greeley, Colo. Civil Engineer.

Track Material for American Engineers in France Should Be Standardized

Sir—Regiments of practical railroad men are being organized under the United States Army engineers for service in Europe. The supposition is that they are wanted for the rebuilding of destroyed lines behind the front, and the building of new lines required properly to serve the army at the front, and also for operating those and other lines leading back to the base that may be turned over to them. All work handled by them is to be done according to American railroad standards and methods. The question now arises—Have proper arrangements been made to get best results when those regiments reach the field? Have the material and tools to do the work with been properly standardized?

In line with this question, I beg to make a few suggestions. For the purpose of avoiding confusion and saving unnecessary delays that would likely prove very costly, everything should be standardized and as far as possible reduced to one size or class of the same tool or material.

Rails—One section and size of rail suitable for all standard-gage tracks should be selected. This should be one of the standard rail sections in most general use, and one that is being rolled by all the mills of the country. I would say 75-lb. 33-ft. rail would best serve the purpose, with two $\frac{7}{8}$-in. holes at each end of rail for $\frac{3}{4}$-in. bolts. The holes should be 6 in. center to center, with $2\frac{15}{16}$ in. from end of rail to center of nearest hole. Using road ties 6 x 8 in. by 8 ft., this allows joint ties to be spaced 18 in. center to center and all intermediates to be 20 in., giving 20 ties to a 33-ft. rail.

Angle Bars—Angle bars should be ordinary standard bars, 26 in. long, with four holes for $\frac{3}{4}$-in. bolts spaced 6 in. center to center. By having all bolt holes an equal distance center to center, in cases of broken angle bars two pieces can be used to hold the joint until whole bars are secured. Bolt holes should be alternately oval and round, in order to stagger the track bolts and at the same time preserve expansion. Angle bars must allow room next to side of base of rail for a $\frac{1}{4}$-in. shoulder tie-plate.

Tie-plates—Tie-plates should have a $\frac{1}{4}$-in. shoulder, flat bottom, $8\frac{1}{2}$ in. wide by 7 in. long. They should have four spike holes $\frac{11}{16}$ in. square, punched to form a rectangle—the punching to agree with the spike slots of the angle bars, making a combination joint and intermediate plate. Rectangular four-hole punching makes plates suitable for either side and allows track to be respiked without spiking in the old holes, by changing all spikes in the same tie.

Track Bolts—Track bolts should be $\frac{3}{4}$ x 4 in., with oval necks, standard threads and square nuts.

Switches and Frogs—Switches and frogs should be of the standard rail section selected for use in track. Switch points should be the same for all switches—a reinforced three-bridle bar point, 15 ft. long. All accessories should be standard. Only two styles of switch stands should be used—one high rigid stand for main-line switches, and one low stand for inside switches.

Frogs—All frogs should be rigid. Frog numbers should be restricted to two, No 10 for main-line switches and No. 7 for inside switches. A satisfactory and reliable guard rail, with clamps and fillers, should be selected and made standard for use with all frogs.

Switch Ties—The ties for these switches can be combined, two ties per stick, having about six lengths of timber for a set of ties—one cut of each timber, with no loss, making two ties. The timber can be purchased in large orders and shipped to the base yard, where it can be cut into sets, each tie plainly stenciled with the number of the switch and the number of the tie in the switch, these numbers being placed one above the other on end of tie. The switch ties should be numbered consecutively from the head block, which is 0. In that way, sets of switch ties can be kept complete and so delivered direct, without delay or confusion, from the yard to the point where they are to be used.

The value of the thorough standardization of material and tools, as well as methods of handling work, cannot be overestimated.

G. P. DEWOLF.
San Antonio, Tex.

Women Draftsmen

Sir—In your issue of May 31, page 469, a letter is published advising the employment of women draftsmen (or draftswomen), releasing the male incumbents for military service. This letter states that "a large percentage of this work is purely a matter of routine," etc.

As to this statement, one only needs to call to mind the troubles connected with the unlettered draftsman or tracer who is not interested in engineering work in any way. It is very commendable to advise the draftsmen to enlist, but to say that the work is unimportant or is slovenly done by men is a mistake easily apparent to a fair-minded person. The real truth is that draftsmen, as a rule, are returning large value for the meager salary received. They are often students and enlarge the scope and field of engineering by their studies. The writer has been a land surveyor for many years, but really was never a good one until he spent many years as an office engineer and draftsman.

Who is not familiar with the standard advertisement calling for structural draftsmen, when really what is hoped for is that a structural engineer worth $3000 a year can be employed for $1200?

A few years ago a large number of graduates were traced, and it is the writer's recollection that by far the greater number were draftsmen.

Let women enlarge their sphere in every possible way and let the country be valiantly defended, but do not belittle a calling that has been waiting for years for tardy justice.

A. H. Doty,
Kansas City, Mo. Draftsman to City Assessors.

Graphics of Reinforced Concrete Amplified

Sir—In the article in the *Engineering Record*, Mar. 24, 1917, p. 473, W. S. Wolfe has very clearly stated the simpler part of the graphic statics of reinforced concrete. The method as developed by Mr. Wolfe was, I believe, first published in English in an article by William Dunn, in London *Engineering* for Dec. 25, 1908, and was reprinted in this country in the *Engineering Digest* for February, 1909. It does not, as far as the writer is aware, appear in any of the American books.

There is one feature of the analysis which Mr. Wolfe has failed to bring out and which somewhat simplifies his method. If in drawing his force diagram, Fig. 2, the pole distance is taken as some even quantity, the moment of inertia of the beam will equal twice the product of this pole distance multiplied by the area of the funicular polygon A_1ON of his Fig. 3 (measured to the scale of the beam section, Fig. 1). This will be evident from a little study of the construction. With the moment of inertia known, the resisting moment, or the stress in the concrete, is easily obtained from the fundamental formula

$$M = \frac{f_c I}{y}.$$

The analysis as given by Mr. Wolfe takes up only the case of a beam under simple bending stress. The article by William Dunn also gives fully the graphic analysis of beams under axial compression as well as bending stress or, what is the same thing, of eccentrically loaded columns. This covers clearly many of the hardest problems we find in design, and the writer would like to see the text reprinted in order that the method might be better known to the engineers in this country.

Henry C. Hitt,
Engineering Department, Great Northern Ry.
Seattle, Wash.

Convicts on New York State Roads

Owing to the scarcity of labor for road repairs and maintenance in New York, in 1916, a number of gangs of convicts from three of the state prisons were employed in such work. The second deputy highway commissioner, Fred W. Sarr, makes the following report on the results of this experience: "The use of convicts on the highway work resulted in a considerable saving to the state in both the Highway Department and the Prison Department, and it is recommended that the practice be continued, at least as long as the present stringency in the labor market continues." The men were taken to and from the work daily when the roads where they were engaged were comparatively near the prisons, and in other cases they were temporarily housed in rented buildings near the roads. The latter plan seemed to be more satisfactory when the work was more than 10 miles from the prison.

Society Service

A Section Dealing with the Results of Teamwork by Technical Men

THE coalition of existing technical organizations in any one city is perennially proposed by those who have much to do with the running of societies. The cost of service for participating members under the best conditions is quite appalling. From the sordid standpoint, the greater the attendance at a given meeting the less the overhead per capita for light, heat and house rent, to say nothing of the inspiration and influence of the larger numbers. St. Louis and Philadelphia some years ago found a working basis for a combination. Recently, the Buffalo Engineering Society has effected a similar arrangement for coöperation with the chemists, electrochemists, the mechanical engineers and the automobile engineers.

Develop on Democratic Lines

Broad policies on democratic lines intended to give maximum service to all grades and groups of technical men have increased the membership in the Buffalo society from 100 to 700 in three years. The organization has attempted to get away from the national-society idea of having a limited membership and a few meetings at which highly technical papers are presented. It has been found that once-a-week meetings with technical papers not out of reach of the ordinary man interested in technical matters are attended with intense interest. A larger personal field is also served, where the subjects are of layman interest. Such organizations as the Chamber of Commerce, Employers' Association and the teachers have been asked to hear speakers on "Apprenticeship," "Standardization" and "Industrial Education." Employers and manufacturers gladly availed themselves of the opportunity to hear M. W. Alexander on "Hiring and Firing Men."

Community Service

Along community-service lines the society was asked to recommend a consulting engineer to report on pumping stations; and when the bridges of the city were reported in bad condition, city officials were asked to attend a meeting by Prof. C. M. Spofford on "Highway-Bridge Floors."

Committees are manned with the older heads, but always a younger, inexperienced but enthusiastic man is included in the personnel.

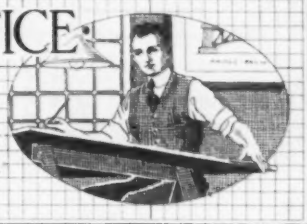
Publicity is handled by one of the members getting in close touch with the newspaper fraternity and enlisting their services and coöperation sufficiently to get reports of meetings printed.

In Buffalo it is felt that a society should not enter too deeply into the question of putting engineers in civic places or into the employment problem, although in the bulletin a few notices are printed for men and positions available.

Recruits to the Engineer Officers' Reserve Corps have been obtained through the medium of a naval and military committee.

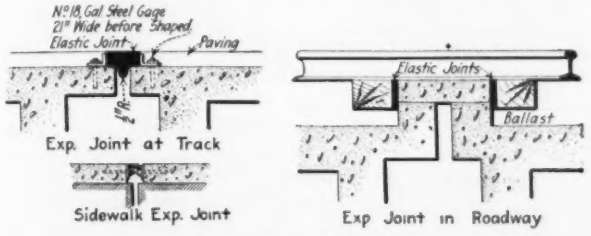
THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT
DEVOTED TO DETAILS OF THE DAY'S WORK



Link Expansion Joints Work on Concrete Viaduct at Denver

MEASUREMENTS taken between extremes of temperature for a year on the linked expansion joints of the Colfax-Larimer viaduct in Denver indicate that all joints work as nearly equally as could be hoped for. As noted in the *Engineering Record* of Oct. 17, 1914, p. 428, and *Engineering News*, June 27, 1916, p. 166, the structure consists of alternate towers and suspended spans, the latter having lengths one-half the distance between bents and being supported by links upon the overhanging



EXPANSION JOINTS ARE DIFFERENT AT TRACK, ROADWAY AND SIDEWALK

girders of the towers. With favorable results on the structure proper, on which to base the design of the joints in the pavement, the problem was to make provision for movement approximately every 80 ft., in such a way that there would be as little annoyance as possible to traffic. Plates or angles projecting in roadways are somewhat of a nuisance, and the thickness of the asphaltic pavement did not render a built-up joint feasible.

The joint, which was adopted after considerable study, is really an adaptation of that designed by Frank L. Raschig for the Gilbert Ave. viaduct in Cincinnati, where it was found to work fairly well. These joints have undergone the test of an exceptionally severe winter in Denver, some being pulled apart at least $\frac{3}{4}$ in. without as yet showing any need of repair; and as for ease of riding, a crack in an asphaltic pavement gives less shock to a vehicle than almost any other form of joint.

One other point in the design of the viaduct having to do with expansion, which has caused some anxiety—anxiety that from experience through the winter does not seem to have been justified—is the laying of sidewalk slabs of 4-in. thickness directly upon the old concrete of the superstructure itself. Although these slabs are completely severed by transverse joints at intervals of about 5 ft., they are monolithic with the curb; and there was some fear that, being exposed to the atmosphere, their rates of contraction would be different from that of the concrete underneath, which difference might result in surface cracking and possible shattering after long exposure. There was some thought of painting the joint with tar pitch or asphalt paint; but it was finally concluded that this would be ineffective, since the concrete of the underlying superstructure, being more or less lumpy, the painting would not overcome the resistance of the mechanical bond. This possible trouble could have been avoided by making the sidewalk monolithic with the superstructure, but previous experience along this line showed that it would be impossible to obtain either a surface to grade or a good alignment of the curbing.

The viaduct was designed by and built under the direction of Herbert S. Crocker, consulting engineer, of Denver.

Old Concrete Foundation Furnishes Most of New Base in Street Widening

By HANS HELLAND, JR.
City Engineer, Paris, Tex.

THE widening of the streets of Paris, Tex., determined upon after the disastrous fire of Mar. 21, 1916, required a change in crown and the removal of old walks and curbing. The latter will be taken out before the street is turned over to the contractor, and there will then remain practically nothing but earth for the contractor to remove.

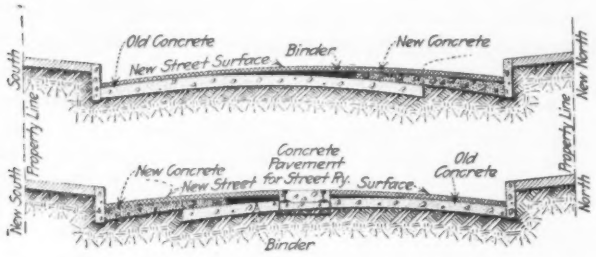
To take care of the change in crown, it is not intended that the old concrete base will be taken out, but the new base, where practicable, shall be built over and on the old construction, which will first be thoroughly cleaned.

EXTRA WIDTH WAS TAKEN OFF NORTH SIDE OF STREET

The additional concrete will in no case be less than 3 in. thick. Where a thickness of less than this is required to bring the old base up to the new grade, binder such as is commonly employed in the construction of asphalt pavement will be used. The cross-section shown in the accompanying drawing indicates the manner in which the new concrete base and binder are to be put on the street.

Where the new grade comes in conflict with the old base, the entire base at that place will be removed and a

new base of proper thickness built up to the correct grade. All old gutters that have been badly burned, chipped or cracked will be replaced. For various reasons it was decided not to move the street-car track. As the track was



ADJUSTMENT LESS THAN 3 IN. THICK MADE WITH BINDER

approximately 2 ft. south of the center of the old street and as the new center line for the street will be 5 ft. south of the old center line, this will leave the track 3 ft. off center to the north.

The "Retort Courteous" for Inspectors Troubled with Sloppy Concrete

THE tower was a little low and the chute was flat. The contractor might have spouted the concrete a little short of its destination, wheeled it a little way and placed it in a manner satisfactory to himself and to Mr. Donohue., bridge inspector of the City of Cleveland. Or, he might have removed a few form braces, lowered his chute and thus avoided, with little labor or delay, the necessity for hydraulic sluicing to get his stone, sand and cement into the form. But the yardage was small; and the contractor was determined to run it "wet," if he could possibly "put it over."

The argument waxed hot, the contractor pointing out to Mr. Donohue that, in the existing state of affairs, one end of the chute would not go up and the other would not go down, and the concrete would have to be made so that it could run to place.

"Now, look here, Bill," retorted Mr. Donohue, "we aren't making our concrete to fit your chutes. You hang your chutes to fit our concrete."

Stitch Rivets Spaced for Bending

By EDWARD J. SQUIRE
Civil Engineer, Brooklyn, N. Y.

IN *Engineering News-Record* of May 10, p. 327, Alex W. Mosely found the spacing of rivets required to fasten together two 6 x 3½ x ½-in. angles, used as a strut 96 in. long in order to make the slenderness ratio of one angle between rivets equal to the slenderness ratio of the strut as a whole. A more rigid requirement, however, is to use enough rivets to develop the shearing stress that acts along the axis of the strut. This shearing stress is the result of flexure and is obtained by making assumptions similar to those made in determining the size of lattice bars.

The A. R. E. A. column formula gives an average allowable unit stress of $16{,}000 - 70\frac{L}{r}$ lb., per sq.in., where L is the unsupported length of the column in inches and r the least radius of gyration of the cross-section. It is usually assumed that the shear due to flexure is equal to that which would be produced by a uniform load of w lb. per ft. applied perpendicular to the column axis so as to cause a unit stress of $70\frac{L}{r}$ on the extreme fibers. In the case of a column with fixed ends, the load w must be sufficient to produce this fiber stress in a length equal to $\frac{L}{2}$.

The uniform load w is determined from the flexure formula, $M = \frac{SI}{c}$, in which M is the maximum bending moment, S the unit stress on the extreme fiber, I the moment of inertia Ar^2, and c the distance of the extreme fiber from the neutral axis. For a fixed-end column,

$$M = \frac{w}{8}\left(\frac{L}{2}\right)^2 = 70\frac{L}{r} \cdot \frac{Ar^2}{c}$$

Let the total load $= W = wL$.

$$\frac{WL}{32} = 70L\frac{Ar}{c}$$

$$W = 2240\frac{Ar}{c}$$

The maximum shear is

$$V = \frac{W}{2} = 1120\frac{Ar}{c} \qquad (1)$$

The intensity of the shearing stress due to the load W acting on the plane $Y - Y$ along the axis of the column may be determined from the expression

$$S_s = \frac{VQ}{Ib}$$

in which S_s is the unit shearing stress in pounds per square inch, Q is the statical moment of the area of one angle about the axis $Y - Y$, I the moment of inertia of the cross-section about the axis $Y - Y$, and b the width of the section at $Y - Y$. The total shear per inch of length is

$$S_s b = \frac{VQ}{I} \qquad (2)$$

The pitch of the rivets connecting the two angles will be

$$p = \frac{R}{S_s b}$$

where R is the resisting value of the rivet in single shear. Substituting in equation (2) the value of V obtained in equation (1),

$$S_s b = 1120\frac{Q}{rc}$$

In the case of the strut composed of two 6 x 3½ x ½-in. angles, $Q = 4.87$ sq.in., $r = 1.45$ in., and $c = 3.75$ in. Then

$$S_s b = \frac{1120 \times 4.87}{1.45 \times 3.75} = 1004 \textit{ lb. per in.}$$

Assuming ⅞-in. rivets and a value in single shear of 7220 lb., the required pitch is

$$p = \frac{7220}{1004} = 7.2 \textit{ in.}$$

Although the above results are empirical, it seems necessary to make a calculation of this nature for the spacing of stitch rivets to provide for bending in the column.

NEWS OF THE WEEK

Current Events in the Civil Engineering and Contracting Fields

Fee System of Cantonment Contracts Made Public

Count on Loyalty of Contractors To Secure Speed, Economy and Proper Construction

The War Department authorizes the following, under date of June 16:

Col. I. W. Littell, of the Quartermasters' Department of the Army, who is in charge of the work of building the new Army cantonments, today made public the fee system of the cantonment contracts. The fees vary from 10% on small contracts of $100,000 or less to 6% on contracts of more than $3,500,000, with a final upset limit of $250,000. The fees in all cases cover both profit and overhead expense. They were fixed upon by the department acting with the assistance of the Emergency Construction Committee of the General Munitions Board and other civilian advisers.

Three Points To Consider

"In deciding on the cantonment contracts we have had to consider three main points of practically equal importance," Colonel Littell said. "The first has been the absolute necessity of speed; the second, proper construction, including sanitation and communication and transportation facilities; the third, economy. Taking all three into consideration, and also the fact that time will not permit the completion of drawings and specifications which would be necessary in order to ask for competitive bids before the work must be started, the Quartermaster Corps, acting in conjunction with the Emergency Construction Committee, decided to make contracts on the percentage, or cost-plus basis, at the same time using all possible safeguards in the shape of guarantees from the contractors as to their capacity and integrity.

Contractors Loyal and Patriotic

"The profit system has been decided on only after weeks of study to find a basis for the fees which would assure the country of the highest grade of work from the contractors and at the same time prevent extravagance through the payment of excessive profits. It is a pleasure to pay tribute to the loyalty and patriotism of the great majority of contractors who have come here to discuss the question with us. With a few exceptions they have acquiesced willingly in our contention that the profits must be kept down to the lowest level consistent with high-grade work. Some firms have offered to do the work on a cost basis, but we have considered this an unwise policy both economically and nationally. The utmost speed and efficiency must be developed in these and future building jobs for the Government, and the acceptance of offers of free service might easily disrupt the high-grade contracting firms best qualified to do the work effectively.

Check on Prices of Materials

"Steps are being taken by committees also to safeguard the Government from paying unreasonable prices for materials. These committees are mobilizing the resources of materials in the various branches, coördinating the supply and demand and fixing prices which will give the material interests a fair, low margin of profit, but with a tendency in all cases to make these prices somewhat lower than the prevailing market rates for each commodity.

"This carefully graded scheme will, of course, not be satisfactory to some contractors, and we have naturally received many protests against the low fees. It is a satisfaction to know, however, that the great majority of the reputable firms have assented loyally and patriotically to the Government's determination to take radical precautions against excessive profits. The criticisms of the few are perhaps the best evidence we could have of the care the Government is taking in its plans for the cantonments."

The schedule of fees follows:

If the cost of the work is under $100,000, a fee of 10% of such cost.

If the cost of the work is over $100,000 and under $125,000, a fee of $10,000.

If the cost of the work is over $125,000 and under $250,000, a fee of 8% of such cost.

If the cost of the work is over $250,000 and under $266,666.67, a fee of $20,000.

If the cost of the work is over $266,666.67 and under $500,000, a fee of 7½% of such cost.

If the cost of the work is over $500,000 and under $535,714.29, a fee of $37,500.

If the cost of the work is over $533,714.29 and under $3,000,000, a fee of 7% of such cost.

If the cost of the work is over $3,000,000 and under $3,500,000, a fee of $210,000.

If the cost of the work is over $3,300,000, a fee of 6% of such cost.

The total fee to the contractor hereunder shall in no event exceed the sum of $250,000, anything in this agreement to the contrary notwithstanding.

Select Sites for Sixteen Army Cantonments

The following additional cantonments for the Army have been announced by the War Department: Rockford, Ill.; Yaphank, South Haven, L. I.; Annapolis Junction, Md.; Petersburg, Va. The 12 cantonments already selected are as follows: Ayer, Mass.; Wrightstown, N. J.; Columbia, S. C.; Atlanta, Ga.; Chillicothe, Ohio; Louisville, Ky.; Battle Creek, Mich.; Little Rock, Ark.; Des Moines, Iowa; Ft. Riley, Kan.; Ft. Sam Houston, Tex., and American Lake, Washington. The War Department has awarded to Hurley Mason & Co., Tacoma, Wash., the contract for building the cantonment at American Lake; to Rinehart & Dennis, Charlottesville, Va., camp, and to Porter Brothers, Portland, Ore., the building of the cantonment at Battle Creek, Mich.

Gets Pneumatic Mixer Verdict

The St. Louis Circuit Court, Apr. 25, handed down a decision awarding judgment of $2000 to the Pneumatic Mixing and Placing Co. in pursuance to its suit against the James T. McMahon Construction Co., of St. Louis, for breach of contract. The firm had used a pneumatic mixer of identical make sold to it by another company. The suit was based on profits of 50c. per yard.

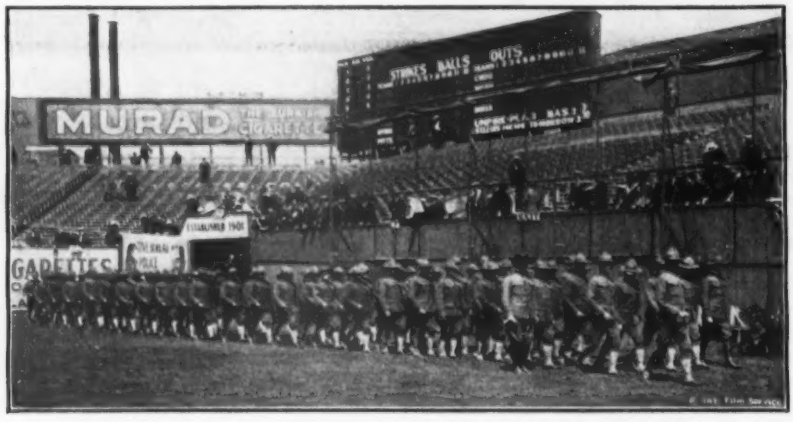
Look Forward to After-War Conditions

Industrial Exposition aud Export Conference Will Outline Plans for Co-operation

From June 23 to June 30, inclusive, there will be held in Springfield, Mass., an industrial exposition and export conference, which has the backing of many of the leading figures of the industrial life of New England, as well as the coöperation of the Department of Commerce, the United States Chamber of Commerce, the National Association of Manufacturers, various shipping and transportation companies, banks and associations having to do with the commercial life of the country at large.

Plans for coöperative work among the manufacturers will be outlined to take care of the possibility that enlarged American industries will quickly oversupply domestic demands, and that production as a result must be curtailed, or new markets opened up. Sessions of the export conference will be held under the direction of experts of the United States Department of Commerce and exhibits of various industries will attempt to coördinate New England's activities. In plan, the scheme will parallel the famous trade shows of Holland, Glasgow, London and other European trade centers, and should be of great educational value in many directions.

Benefit Ball Game for First Reserve Engineer Regiment



THE FIRST RESERVE ENGINEER REGIMENT, COLONEL C. H. MCKINSTRY COMMANDING, AT THE POLO GROUNDS FOR THE BENEFIT BALL GAME BETWEEN THE YANKEES AND ST. LOUIS. THE REGIMENT, RECRUITED AND ORGANIZED IN NEW YORK, IS SOON TO EMBARK FOR FRANCE

Take Optimistic Attitude Toward Construction

World's Salesmanship Congress Delegates Predict Business Activity

That the participation of the United States in the world war will bring tremendous business activity to this country and that this is no time for a pessimistic attitude toward construction activity was the sentiment of the delegates to the Building and Construction Section of the World's Salesmanship Congress held at Detroit last week. A committee, headed by Albert Moyer, sales manager of the Vulcanite Portland Cement Co., was appointed to draft suitable resolutions crystallizing this thought. The resolutions as finally adopted are, in part, as follows:

"Whereas, The entrance of the United States into the world war has resulted in a certain natural tendency to retard building activity and has brought about an inevitable temporary disturbance in commercial and industrial conditions, and . . . the time is at hand when productive enterprise was never so necessary nor so feasible; therefore, be it

"Resolved, That it is the duty of the American business men to preserve normal conditions, but to avoid waste. . . . Business in war time is not 'business as usual.' It is a time for unusual business. . . . No useful purpose is served by economy which means reducing our demand for useful things. . . . It is important that there be no let-up in work contributing to industrial productivity. There is need for increased factory capacity, in larger storage facilities and better means for the rapid transportation of munitions, food and merchandise, in vastly increased quantities."

The resolution goes on to say that roadbuilding should continue so that it may be possible to cultivate and market crops, and to supplement the railroads in their distribution problems.

The resolutions are to be transmitted to the national Congress.

Col. H. T. Bope, vice president and general manager of sales of the Carnegie Steel Co., said that in 1918 the production of steel ingots in this country will reach 47,000,000 tons and that his company is working energetically to find new uses for steel to take up this greatly increased production, characterizing as erroneous the report that the building of a great fleet of steel cargo ships has so seriously taxed the steel production of the country as to bring about a scarcity that would cripple regular lines of activity.

New York Highway Commission Curtails Its Program

The New York State Department of Highways is reducing its engineering force owing to the abnormal conditions caused by the war, according to a statement made by Commissioner Edwin Duffey. Should conditions improve the department is in shape to and will promptly take advantage of the change and bring its work up to normal conditions. In the meantime the department is exerting itself to secure employment in private work for as many of the engineers as possible. The shortage of labor which existed last year is becoming more acute and road builders are having great difficulty in obtaining shipments of road-building materials due to lack of cars.

The department is bending all its energies toward the completion of contracts already in force, which aggregate approximately 900 miles and constitute about a years' work under normal conditions. Most of the contractors are running at about 30 to 50% of their normal efficiency, while many have been unable to commence operations.

Illinois Recruiting Guard Regiment of Engineers

Three Companies Up to Strength —Citizens Committee, Headed By Randolph, Helps

Having recruited to full strength the Third Regiment of Engineers, Chicago engineers are now filling up the regiment of engineers recently ordered recruited to accompany the National Guard of Illinois and Wisconsin. Col. Henry A. Allen, chief engineer of the Illinois National Guard, is to be the commanding officer. Three companies are practically up to war strength now.

Three officers of Company A are men who went to Texas last summer. Capt. C. C. Saner and Junior First Lieut. W. H. Dean are assistant engineers in the city engineer's office. Second Lieut. D. A. Tomlinson, valuation engineer, Chicago & Western Indiana Ry., is detailed as recruiting officer. First Lieut. J. A. Rossiter, track elevation engineer, has seen service in the Philippines. Capt. B. C. Allin, of Company B, is in the employ of the Chicago, Rock Island & Pacific. Capt. H. S. Baker, of Company C, principal assistant city engineer, spent last summer as first lieutenant in Company A in Texas. W. H. Allen, consulting engineer, is captain of Company D. All applicants for officers' positions are passed upon by Col. H. A. Allen, Colonel Riché, Lieut. Col. T. W. Winston, Col. Gordon Strong and Isham Randolph.

The municipal pier is being used as an armory, bulkheads now being placed in the freight-house floor for lockers and equipment. Drills are held on the second floor. The regiment will be called out July 25, and active recruiting is going on at seven different stations in Chicago. A citizens' unit of business men, headed by Isham Randolph, consulting engineer, is backing the formation of the regiment and will continue to look after the physical comfort of the men and their families. The six companies will require about 100 engineers and the remainder desired are skilled artisans, such as carpenters, electricians, enginemen and other railway men, machinists, photographers, pipe fitters and quarrymen.

May Need Two Billion Feet of Lumber for War

Estimates prepared by the Lumber Committee of the Advisory Commission of the Council of National Defense show that 2,000,000,000 ft. may be used for purposes directly connected with the war in the next 12 months. Construction of the 16 cantonments which will house the new army will absorb a large amount of the Government's lumber purchases. The cantonments will require about 500,000,000 ft. Second in quantity of lumber required comes the wooden ship-building program now estimated at 400,000,000 feet.

Massachusetts Uses a New Form of Road Contract

To meet the conditions imposed by the present shortage of materials and labor, and the difficulty of obtaining equipment for road work, a new form of contract is being tried out by J. A. Johnson, division engineer, Massachusetts State Highway Commission. Under the terms of this form the contractor is relieved of the gamble on labor and materials. The contractor's weekly payroll is kept by a state inspector or superintendent, sworn to by the contractor, and then is paid by the state. A maximum limit to the daily wage rate has been set, but otherwise the contractor is absolutely free to make his own conditions. The state furnishes all materials and pays the rental on large pieces of equipment like rollers, etc. Under this arrangement the state is obliged to rely on its inspectors and upon the integrity of the contractors in order to secure efficient work, but on account of the care used in selecting the contractors the scheme is working out to advantage.

Lumber Manufacturers Organize Order-Distribution Bureau

Organization of the Southern Pine Emergency Bureau, whose duties it shall be to arrange for the distribution of lumber orders received from the Government or from contractors having governmental work, was effected recently at a meeting of subscribers to the Southern Pine Association, held in Memphis. The bureau will have headquarters at New Orleans, and will be under the direction of W. J. Sowers, of Epley, Mississippi.

New Jersey Highway Commission Appoints Temporary Surveyors

Pending the holding of civil-service examinations, the New Jersey State Highway Commission decided, June 14, to employ eight inspectors and six surveyors in connection with the designation of state-highway routes. Charles A. Meade, engineer of the Public Utilities Commission, was retained in charge of bridges to supervise such construction on the state-highway system. General Goethals attended this session of the commission, which was executive.

Get No Bids on $131,500 Road Bond Issue

The commissioners of Stark County, Ohio, in which is located Canton, recently advertised $131,500 road-improvement bonds, asking for bids to be delivered June 5. The bonds were to pay the county's and township's share of the cost of improving several roads this year. Up to June 6 no bids had been received, although the commissioners had a proposition from one bonding house and may be able to accept this if there are no legal difficulties involved.

Engineers at Washington Rush Work on Army Camps but There Is Much Delay

Dispatch Says Sites Are Selected, Some Contracts Let but Much Advice and Decentralization of Authority Holds Up Design

WASHINGTON, D. C., June 19.—Of all the vast preparation now under way here, no one has more appeal for the engineer and contractor than the design and construction of the 16 cantonments for the new National Army to be selected for training from the nine million-odd men registered for service on June 5. Such official notices as have been given out have placed the manning of these camps at Sept. 1, although now there seems to be some hedging on that date. Ten weeks have elapsed since the declaration of war. Ten weeks only will elapse before the camps must be ready, and yet today no construction has started on any one of the huge cities—for cities they are which will house thirty thousand or more men and will contain about 1200 buildings of large size.

What is the reason for the delay? What progress is being made toward the completion of the work?

Army Quartermaster in Full Charge of Work

In the first place, the construction of the cantonments is in sole charge of the Quartermaster's Department of the United States Army. When the army gets to France in all probability camp construction will devolve upon the engineers, but at home the quartermasters have always had it in charge, and they will continue to do so. In many ways they are well suited for the job. They have had experience in the routine though minor camp construction of the past. Already in the present war they have completed without outside engineering aid the design and construction of a dozen officers' training camps and what is more remarkable and hitherto unannounced *nine cantonments to house 150,000 men* added to the regular army. These camps, located at army posts, were practically all completed in the 30 days from May 15 to June 14. In one of them, which is soon to be featured in movie films throughout the country, a wooden building 25 x 220 ft. in plan was erected complete in 90 minutes!

Last year the Quartermaster's Department prepared designs for a standard army cantonment to suit enlarged army requirements. This design was all ready for use when came the declaration of war, the visit of the foreign missions and the advent of the Council of National Defense and its civilian committee advisers. As a result of conferences with these last three, the design was radically revised—mainly to avoid certain proved deficiencies found in European conditions and to meet the stricter requirements of a recruit army over those of seasoned regular troops—for whom the original army camp was designed. On account of this revision, and the consequent increase in cost, it was decided—but only within the last few weeks—to build 16 cantonments instead of the planned 32 and to quarter the National Guard branch of the army in tent camps.

Committee Recommends Contractors

The new conditions in Washington brought about a revision in organization whereby the whole matter of selection of contractors was put in the hands of the Committee on Emergency Construction and Engineering Works, reporting through the Council of National Defense to the Secretary of War, while the Quartermaster's Department remained in charge of the design and construction. This committee makes all investigations and decisions as to the contractors and recommends the assignment of certain contracts to certain contractors, which assignments are made by the Secretary of War.

Quartermaster's Organization Good

The organization for the building of the camps is fairly simple—with one exception, which is most important and will be noted hereafter. Reporting to the Quartermaster General is Col. Isaac A. Littell, U. S. A., who is in charge of all camp construction. Under him is Maj. W. A. Oury, U. S. A., and, in charge of the new cantonments, Major Marshall, U. S. A. Under Major Marshall are four divisions, each headed by a major in the Quartermaster's Reserve Corps: Engineering and Design, under Maj. F. M. Gunby, late of the office of C. T. Main, Boston, Mass.; Construction, under Maj. M. J. Whitson, late of Grant Smith & Co., St. Paul; Accounting and Contracts, under Maj. W. A. Dempsey, late chief clerk of the Quartermaster's office in New York, and Materials and Transportation, under Maj. R. E. Hamilton, late purchasing agent of Stone & Webster in Boston.

Attached to Major Gunby is a designing force which embraces a number of paid engineers and a few volunteer experts, among whom may be noted Dabney H. Maury, of Peoria; F. B. Wheaton, an architect of the Quartermaster's Department, and numerous city planning experts. This force is designing the cantonments—but in this design they are advised by the Committee on Emergency Construction, which has attached to it a number of volunteer experts, such as George W. Fuller, Leonard Metcalf, Asa E. Phillips and Nicholas Hill. So far as can be ascertained, this committee's service is purely

advisory and without authority except as it can obtain action upward through the Council of National Defense over to the Secretary of War and thence downward through the Quartermaster.

In addition there seem to be several other committees of the Council of National Defense who exercise advisory functions and who are not overly careful in such advice to expedite the design of the cantonments. In all of this advisory work there is unwieldiness; in some there is friction. The current delays are almost entirely due to this.

Under Major Whitson is the constructing force, which consists of an as yet unfixed number of division superintendents and a unit organization at each camp comprising a constructing quartermaster, who will be either a regular or reserve officer in the army and will be in command at each camp; a civil engineer, who will be in charge of the engineering work and who will be employed for the job, and the usual organization of accountants and foremen, some of whom will be commissioned and some not.

Why Work Is Progressing Slowly

What has been done so far can be stated as follows: All 16 cantonment sites have been selected by the department commanders of the Army and preliminary surveys made at nearly all the sites. Seven contracts have been announced. The standard cantonment, which must be fitted to the varying topography of each site, was all but completely designed last week, when the interference of more or less unrelated committees—mainly those made up of medical men—forced it back to the designing tables, where it still is.

Contract difficulties are not holding up the camps—though daily newspaper correspondents seem anxious to convey that notion. The main difficulties chargeable for the unexpected and annoying delay in the camp work to date seem to lie in the scattering of authority, in the failure to concentrate in one man less burdened and of more technical experience than the Secretary of War the responsibility for final decision. The situation calls for the kind of centralization of authority that was finally established at Panama. Here is a $75,000,000 job—and the money must be spent in 10 weeks. There are bound to be mistakes; human ability is limited. But there are undoubtedly available in this country many men any one of whom can accept the report of his subordinates and who can listen with attention to his advisors, but who can in short order and with a fair degree of effectiveness put down his fist definitely and say—"*This* must and shall be done and done now; *that* may be desirable under certain hypothetical conditions, but such refinements shall not delay our progress." If the present diffusion of authority is continued over to the construction operations, delays will multiply beyond endurance.

F. C. W.

Municipal Work Replies Show Variance

Opinions from More Cities Give Impression, However, of Much Work Under Way

Further letters from engineers having public work in charge have been received since last week's issue and indicate that the impression drawn from the first replies was a fair index of general conditions. While there is a tendency to hesitate before undertaking any but the most necessary construction, this is brought about by the difficulty of getting labor and materials, and should provide, at the war's end, a means of absorbing the excess of resources.

The difficulty of selling municipal bonds will seriously affect public construction, in the opinion of John Ericson, city engineer of Chicago. However, work has already been started on bridges which will cost about $3,000,000, of which over $1,250,000 will be spent in 1917. Water-works construction will be somewhat reduced on account of the high prices of cast-iron pipe, lead and other materials, but the Wilson Ave. water tunnel and the Mayfair pumping station will be completed this year at a total expenditure of $1,730,000, and the municipal shops and power house will be finished at a cost of $515,000. Paving and sewer construction will go ahead actively, being paid for from special assessment funds, as will the widening of 12th St. and Michigan Avenue.

Plenty of Labor in Omaha

Though John A. Bruce, city engineer of Omaha, is of the opinion that the labor needed to carry on public work is available, he anticipates much difficulty in securing materials due to car shortage. Prices are approximately 15% higher than last year, but this advance does not seem to have any effect upon the amount of work petitioned for. In fact, in Mr. Bruce's opinion, more work will probably be done this year than during 1916, there being $600,000 worth of paving work under contract at the present time. In addition to this, sewer work amounting to $250,000 has been let and plans have been drawn for approximately $200,000 additional. All construction work has been interfered with during the past month, due to a large extent to sympathetic strikes involving teamsters, and the attendant delay in the delivery of materials.

Limit Laying of Water Mains

In Minneapolis, public-improvement work, excepting building, is done by force account, and F. W. Cappelen, city engineer, states that there is no shortage of labor and no shying at high prices for materials yet. He is proceeding with new work that has been ordered, excepting that the laying of water mains has been curtailed.

In the Twin Cities, public improvements are largely inaugurated by petition, and there is a marked dropping off of such petitions within the last few weeks. This condition will not be reflected until next season. It is also probable, in the opinion of Mr. Herrold, that the unsettled feeling of the present may change as the new conditions are realized and accepted, for engineers and contractors see no prospect of lower prices. If these new conditions are recognized soon enough, work may be ordered during the coming winter to equal the present year's large construction program.

Public Works in Cincinnati

It is not probable that a great deal of public-works construction will be carried on in Cincinnati during the coming season, due to the high cost necessitating revision of estimates, according to F. L. Raschig, principal assistant engineer of the Board of Rapid Transit Commissioners. A large amount of work is on streets containing street-railway tracks; and as there is little prospect of getting the rails before fall, very little of the above work will be undertaken.

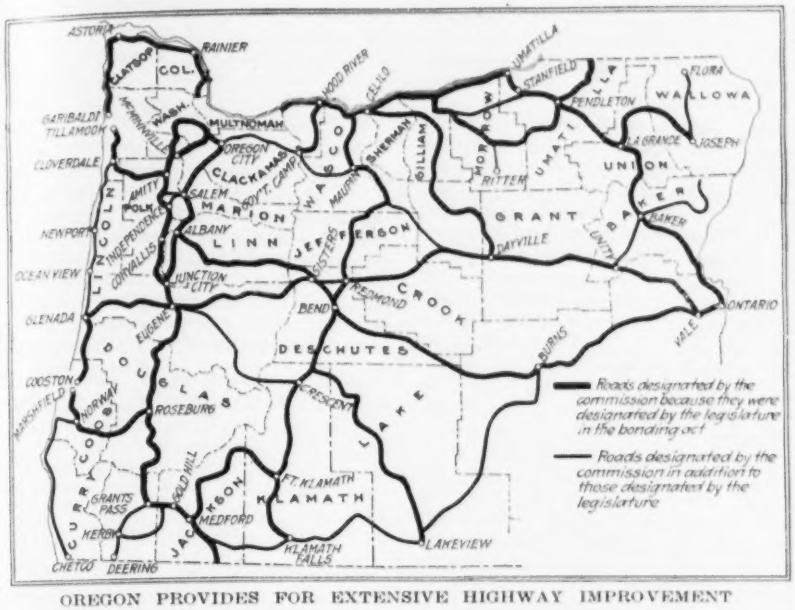
There will probably be a large amount of sewer work contracted for during the year. Contracts for Nos. 5, 6, 7 and 8 of the Mill Creek interceptor will be let. The total amount involved is about $810,000 for about 24,000 lin.ft. of sewer. A sewer system for the suburb of Madisonville will be contracted for, costing about $210,000. Bids will be asked for on relief sewers for the suburb of Avondale, costing about $65,000. Plans for the new rapid-transit system, to cost about $6,000,000, are under way, but it is not probable that any work will be started before the end of the year.

A report from Lyonel Ayres, city engineer of Duluth, indicates that the amount of work to be done will be small in comparison with the last two years, but this is accounted for by the condition in which the former city government left the permanent-improvement fund.

Contractors on improvement work in smaller cities of the Northwest report plenty of work, except in building construction. Car shortage and material deliveries are the only serious factors.

California Grade Crossing Now Under Commission Ruling

The Railroad Commission of California will now have jurisdiction over railroad crossings both in and out of cities, according to a State Supreme Court decision handed down in Los Angeles on June 10. The suit was on the question of whether the City of Los Angeles had jurisdiction over railroad crossings within its own boundaries. The decision, written by Justice Shaw, states that the regulation of railroad crossings is a state and not a municipal affair, because the constitution contemplates a state-wide regulation of all railroads free from local interference.



OREGON PROVIDES FOR EXTENSIVE HIGHWAY IMPROVEMENT

Alvord and Greeley Investigate Sanitation of Cantonments

John W. Alvord has been appointed to investigate and report on the sanitary features of the plans for the Army cantonment at Rockford, Ill., and S. A. Greeley has been designated for similar work in connection with the military city at Battle Creek, Mich.

Hudson River Bridge and Tunnel Commission Named

Governor Edge, of New Jersey, has named the following as members of the Hudson River Bridge and Tunnel Commission: Thomas N. McCarter, T. Albinus Adams, Morris Rachlin, Franklin Murphy, Theodore Boettger, Thomas LaMonte, William H. Noyes, Alboni H. Allen, Palmer Campbell and Col. J. H. Wells.

Professional Classes War Relief Council Sends Thanks

In a letter to L. B. Stillwell, treasurer of the American Fund for the British Professional Classes War Relief Council, Leonard Darwin, chairman of the council, sends his thanks and expresses in behalf of his organization its appreciation of the contributions of American engineers. A total of $11,793.25 was the amount of the subscriptions voluntarily made by 1154 American technical men to this fund.

Surveying Site for Armor Plant

A contract was awarded June 6 to Van Ness & Sons, Charleston, W. Va., for the survey of the site for the new Government armor plate plant at Charleston. The contract, calling for complete topographical maps to be finished by June 20, was awarded at $2500.

Concrete Ship To Be Built at San Francisco

A group of San Francisco capitalists have combined to finance a $200,000 venture for trying out a scheme for constructing ocean-going vessels of concrete. The plan has been developed by Alan MacDonald, of MacDonald & Kahn, construction engineers, of San Francisco, who will supervise the construction of the experimental vessel. Work is to start at once in a shipyard laid out for this purpose on San Francisco Bay near Redwood City.

Hull 6 In. Thick

The concrete vessel will be about 300 ft. long, with a cargo capacity of 4500 tons. The shell of the hull is to be about 6 in. thick, made of the best concrete it is possible to mix, reinforced with steel rods welded together. The weight of the hull is to be less than the weight of a wooden hull for the same cargo capacity. In fact, it was a comparison of the weight and the efficiencies of joints in wooden vessels and in reinforced-concrete structures which first drew attention to the use of concrete in ship construction and resulted in the development of the scheme now being tried out. A study of modern wooden shipyard methods developed the fact that the weight of bolts used in the usual wooden vessel is more than the weight of reinforcing called for under the scheme proposed by Mr. MacDonald.

Built in 90 Days

About 90 days will be required to build the first vessel. If the scheme is found to be successful, it is pointed out, any number of boats could be built without dependence upon Eastern steel mills; and at the rate of only 30 to 60 days' actual construction time on each hull, a large yard could turn out ships at an unprecedented rate.

Oregon To Issue Road Bonds for $6,000,000

Farmers Vote Against Proposition Which Carries by 14,000— Automobiles To Pay

At an election held June 5, Oregon voted in favor of the bond issue for roads by a majority of 14,000. Six million dollars in bonds will be issued during the next five years to construct a system of state highways. Multnomah County, in which Portland is located, saved the day for the rest of the state, even though it will not receive a foot of paving under the bond issue. Although the money will be derived from license fees on automobiles, the farm vote was solidly against the bond.

The ratification of the road-bond issue will ultimately give Oregon a comprehensive and constructive road system. Within the next few years the state will have several hundred miles of hard-surfaced road, in addition to a network of post and forest roads. Twenty miles of paving have already been ordered by the State Highway Commission under this issue of bond, and the first 10 miles will be on the road from Pendleton east over the route leading to Walla Walla, Wash., and the second 10 miles will be on the Rex-Tigard road, between Tigard and Newberg. This action was taken by the Highway Commission on condition that the respective counties immediately prepare the grades for receiving the hard surfaces.

Local bonds voted in Douglas County, Grant County and Tillamook County add additional sums of $550,000, $143,000 and $450,000 to the state issue.

Engineers with Pershing

Accompanying General Pershing to France were Col. Harry Taylor, Capt. Ernest Graves and Capt. Robert G. Alexander, from the Corps of Engineers, United States Army.

Kansas Commission Approves Road Engineers

The Kansas Highway Commission approved the county engineers in sixteen counties under the provision of the recent Highway Law, which gives the Commission authority to pass upon the competence or incompetence of the work of the highway engineers. The list of the approvals follows: H. A. Rowland, McPherson County; C. M. Cooper, Cherokee County; W. B. Harris, Reno County; G. P. Myland, Smith County; R. F. Gallup, Marshall County; H. K. Hibbard, Montgomery County; L. P. Price, Nemaha County; A. E. Smith, Morris County; W. S. Ruggles, Lyon County; W. J. King, Labette County; H. S. McFadden, Wilson County; C. C. Eastham, Harper County; R. D. Coleman, Atchison County; William S. Henderson, Washington County; T. J. Schall, Ford County; H. L. Parker, Osborne County.

Engineering Societies

The Colorado Association of Members of the American Society of Civil Engineers will discuss at the June 9 meeting the report of a committee on relations of local associations to that society, to other engineering organizations, to engineers and to the public. This discussion is held at the request of the secretary. The association announces that regular evening meetings will be omitted, but the Wednesday luncheons will be continued during July and August.

The American Institute of Chemical Engineers will hold its ninth semi-annal meeting at Hotel Statler, Buffalo, N. Y., June 20 to 22. The program includes an inspection of the Buffalo Foundry and Machine Co. and many other points of interest.

The American Institute of Electrical Engineers will hold a special meeting in New York, June 27 to 28, for the presentation and discussion of papers that were to have been read at the annual convention, which has been cancelled.

The Oregon Society of Engineers, at a meeting held June 8, was addressed by O. P. M. Goss, consulting engineer for the West Coast Lumbermen's Association. The subject of Mr. Goss' talk was lumber and its uses. The use of lumber in mill construction, shipbuilding, paving, water pipe, bridges, etc., was demonstrated, and lantern slides, illustrating artistic types of timber highway bridges as well as the more usual forms in which wood is used, were shown.

The Society of Industrial Engineers, which was previously organized at Chicago on May 26 and commented on in an editorial in last week's isue, is to include "men and women who are industrial engineers, professional technical engineers, accountants, managing executives of commercial and industrial activity, writers, educators and students." One of the purposes, based upon present conditions, is to assist the Government in dealing with manufacturing and industrial interests, and the plan provides for listing all industrial specialists qualified to serve either as advisers or directors of efficiency work. The permanent organization and election of officers are to take place at Washington, D. C., on June 15, but Charles B. Going, of New York, for 20 years editor of "Engineering Magazine," has been chosen provisional president.

The Indianapolis Chapter of the American Association of Engineers was formed May 31, with D. B. Luten, chairman, and T. H. Kucharski, secretary. Among the members are E. H. Mayo, consulting mechanical engineer; Charles Brossmann, consulting engineer, and H. O. Garman, chief engineer, Public Service Utility.

Canadian Electric Railway Association—At the annual meeting of the Canadian Electric Railway Association held at Montreal, June 5 and 6, the following officers were elected: President, C. L. Wilson, assistant general manager, Toronto & York Radial Ry., Toronto; honorary secretary-treasurer, Acton Burrows, Toronto; Executive Committee—J. D. Fraser, Ottawa Electric Ry., Ottawa; A. Galoury, Montreal Tramways, Montreal; E. P. Coleman, Hamilton; G. Gordon Gale, Hull Electric Ry., Hull, Que.; J. S. Mackenzie, Winnipeg Electric Ry., Winnipeg; H. G. Matthews, Quebec Ry., Quebec; E. L. Milliken, Cape Breton Electric Ry., Sydney, N. S.; assistant secretary, Aubrey A. Burrows, Toronto. The members were entertained at a dinner given by the Montreal Tramways Co., on June 5, presided over by Col. J. E. Hutcheson; and on the following day some of the properties of the company were visited.

The New York Electrical Society at a meeting held June 14, at the Engineering Societies' Building, New York City, elected the following officers for the ensuing year: President, Dr. A. S. McAllister; vice presidents, J. P. Carey, Walter Neumuller, George H. Barbour; treasurer, Thomas S. Honahan; and secretary, George H. Guy.

The San Francisco Association of Members of the American Society of Civil Engineers held its regular bimonthly meeting Tuesday evening, June 19. George W. Howson, of the Sierra & San Francisco Power Co., described the development of the Stanislaus River with special reference to Strawberry Dam, illustrating his remarks with stereopticon views. The report of the special committee of the society on the relations of local associations to the society and to other engineering organizations, and engineers to the public, was freely discussed at this meeting.

The Southwestern Water-Works Association held its sixth annual convention at Topeka, Kan., June 11 to 14, inclusive. John B. Hawley, of Shreveport, La., read a paper on the new filtration softening plant for that town. The electrolysis in water pipes was discussed by Joseph W. Ivy, of Kansas City, Mo. General discussions were held on water meters and metering fire lines. Henry C. Porter, city engineer of Kingsville, Tex., spoke about the financing and building of an adequate water-works and fire-protection system in a city of 5000 population. The officers of the association are: President, Jesse Shaw, superintendent of the Water Co., Topeka, Kan.; secretary and treasurer, E. L. Fulkerson, secretary and general manager, Water Co., Waco, Texas.

Personal Notes

Andrews Allen, James N. Hatch, consulting engineers, of Chicago, and **R. F. Schuchardt,** electrical engineer, Commonwealth Edison Co., have been appointed on a committee by the Western Society of Engineers to assist the Citizens' Municipal War Board in passing tentatively on inventions and patents before they are sent to the National Defense Board in Washington.

Bion J. Arnold, Peter Junkersfeld, Frederick K. Copeland, W. H. Hoskins and Robert W. Hunt, composing the original Illinois State representatives of the Naval Consulting Board to take an industrial census, have been asked to assist the State Defense Board in matters of engineering interest.

Ernest McCullough, major of engineers, Officers Reserve Corps, and engineer with Stone & Webster Corporation, has been ordered into active service and detailed to serve the American Red Cross in France as consulting engineer in the building of hospitals in advance of the arrival of American soldiers, and to serve on the committee of engineers which will serve in the rehabilitation of France. Until further notice his address will be care of M. Percy Peixotto, 2 Rue des Italiens, Paris, France. Inasmuch as he will be out of the country during the war, Major McCullough resigned as trustee of the Western Society of Engineers. The board elected G. C. D. Lenth, assistant engineer, Chicago Board of Local Improvements, to fill his unexpired term.

Henry E. Elliott is now connected with the Craig Shipbuilding Co., Long Beach, Calif. Mr. Elliott entered the Army of the North, September, 1861, at the age of 14 years. When General Lee surrendered in 1865, Mr. Elliott's regiment was retained to reconstruct bridges until it was mustered out in January, 1866. Mr. Elliott then worked at Rock Island, Ill., on the first iron bridge to cross the Mississippi. From this work he went to the bridges being constructed at Omaha, and Boonville, Mo., and then to many other steel-bridge erection jobs, working for a time under General E. F. Winslow and General Adna Anderson. In the succeeding years Mr. Elliott worked under Robert E. O'Brien, Edwin Thatcher, Robert Gillam, F. A. Molitor and many other men whose names are connected with the construction of railroads and bridges. Although he had reached his seventieth birthday before the present war came, Mr. Elliott felt that every man should do his bit. Since there were five shipyards being constructed at Long Beach, he could not resist the call to render what service he could and threw in his lot with John E. Craig.

Lewis **H. Bond**, formerly roadmaster on the Illinois Central at Carbondale, Ill., has been appointed assistant engineer, maintenance-of-way, with headquarters at Chicago, succeeding **W. G. Arn**, who has accepted a commission in the Chicago railway regiment, the Third Reserve Engineers.

James H. Van Wagenen, who in May, 1916, was appointed engineer for the International Boundary Commission in charge of the direction of all field and office work of the United States Section of the commission, has transferred his headquarters from Washington, D. C., to Danforth, Maine, for the summer in order to be in the general vicinity of the work which is being done by the several surveying parties on the international boundary line. Previous to his engagement with the Boundary Commission, Mr. Van Wagenen was with the United States Geological Survey on topographical surveys in North Dakota, and later was an assistant engineer with the Illinois Highway Commission.

A. Somerville, Jr., who for the last two and one-half years has been on valuation work for the Chesapeake & Ohio Railway Co., is now acting as engineer and assistant to the superintendent on construction for the Boldt-Low Construction Co., Cleveland, Ohio.

W. E. Thompson, formerly with the Keystone Fireproofing Co., of New York, is now superintendent in charge of building construction at Herkimer, N. Y., for Thompson & Binger, of New York City.

J. W. Hruska, formerly in charge of the highway work in LeSoeur County, Minnesota, is now in charge of the roadwork of Waseca County.

R. E. Massey, superintendent of the New York division of the Pennsylvania R.R., has been appointed general superintendent of the Eastern Pennsylvania division, with headquarters at Altoona, Penn., to succeed **George W. Creighton**, deceased.

M. W. Clement, division engineer in the office of the principal assistant engineer of the New Jersey division of the Pennsylvania R.R., has been promoted to superintendent of the New York, Philadelphia & Norfolk R.R., succeeding **T. I. Leiter**, promoted. **C. B. Brown**, chief engineer at Moncton for the Canadian Government R.R., has been appointed assistant general manager of the Eastern lines.

Edward C. Richardson and **Rickard K. Hale** announce that, owing to the call of the National Guard of which they are members, they will close their office as consulting engineers, July 1, 1917. Messrs. French and Hubbard, 88 Pearl St., Boston, Mass., have kindly offered to handle incompleted or new work for former clients of Messrs. Richardson and Hale. It is requested that after July 1 correspondence in reference to work completed by this firm be addressed to Otis W. Richardson, 84 State St., Boston, to whom all files will be available.

James H. Herron, who was inaugurated president of the Cleveland Engineering Society at the thirty-seventh annual banquet, held June 12, was born in 1875 in Girard, Penn. Receiving his early education at the Girard Academy, he served as apprentice at the Stearns

Elected President of Cleveland Engineering Society

JAMES H. HERRON

Manufacturing Co., Erie, Penn., from 1890 to 1894, and then served in the drafting department and as chief draftsman for the Erie City Iron Works, Erie, Penn., from 1894 to 1897. From 1897 to 1899 he studied at the University of Michigan, at this later date taking the position of draftsman with the Cambria Steel Co., Johnstown, Penn., where he remained until 1902, becoming chief engineer at that time of the Bury Compressor Co., Erie, Penn., of which concern he became commercial manager in 1905. In 1907 Mr. Herron became metallurgical engineer for the Detroit Steel Products Co., and in 1899 received a degree of B. S. in M. E. from the University of Michigan. He became a member of the American Institute for Mining Engineers in 1914, at which time he was a consulting metallurgical engineer. Mr. Herron is a member of the American Society for Mechanical Engineers, the American Chemical Society and the American Society of Automotive Engineers.

W. M. Butts, formerly assistant division engineer of the Nashville, Chattanooga & St. Louis Ry., is now in charge of the erection of a $40,000 reinforced-concrete warehouse at San Jose, California.

W. E. Vest, formerly superintendent of water-works of Charlotte, N. C., has recently been appointed city engineer by the new Board of City Commissioners of that town.

Harold McCormick has resigned as county engineer of Pike County, Ohio, to accept the position as county engineer of Rathen County, Virginia. **Joseph G. Bulmer** has been appointed to succeed Mr. McCormick.

W. S. Baver, formerly assistant sanitary engineer of the City of Johnstown, Penn., is now connected with the Clarksburg Engineering Co., successor to Altstetter & Wooters, consulting civil and mining engineers, of Clarksburg, W. Va. Mr. Baver will act as manager of the new company, having had experience in all departments of municipal work.

Obituary

Joel A. Reese, civil engineer, Bandon, Ore., died recently at North Bend, Ore., at the age of 36 years. Mr. Reese was for a number of years in the employ of the Government in river and harbor work in Oregon and Washington.

Harry B. Cramer, chief accountant of the Bureau of Public Roads and Rural Engineering, died at his home in Washington, June 10. Mr. Cramer had held positions in the Geological Survey, the Forestry Service and the Interstate Commerce Commission.

William E. Kimball, city engineer of Attleboro, Mass., and his assistant, **C. E. Jewell**, met with a fatal automobile accident on May 2. **L. J. Ainsworth**, a construction foreman of the State Highway Commission, who accompanied them, was also killed.

William Dubois, for 10 years a map maker for the Panama Canal, died in his 68th year, May 17, 1917, at Ancon, Canal Zone. A veteran of the Franco-Prussian War, born and educated in France, he went into engineering work in Chicago in 1872. He was a draftsman in the office of Rand, McNally & Co. for 25 years, being drafting room foreman 15 years for them. He took service in the chief engineer's office of the Panama Canal at Culebra in 1907.

A. R. Pinsonnault, consulting engineer, died suddenly in Montreal. For some years he was construction engineer of the Intercolonial Ry. and later was with the Canadian Pacific Railway.

The death of **James Spelman**, president of the John S. Metcalf Co., Ltd., grain elevator engineers and builders, of Montreal, London, Chicago and Melbourne, occurred at Westmount, Montreal, on May 27. He was born at Ottawa, Ont., in 1860, and graduated at the Royal Military College, Kingston, Ont. At the outset of his professional career he was engaged in connection with Canadian Pacific Ry. construction in the West, and afterward became associated with the Metcalf company in the work of building grain elevators.

the work of building grain elevators. Five years ago he was elected president of the company, and was prominent in its operations in the United States and England as well as throughout Canada. Only two weeks before his death he returned from a five months' visit to Australia in connection with construction work there. Mr. Spelman was a member of the Canadian Society of Civil Engineers and the Western Society of Engineers.

Joel M. Howard, superintendent of highways, St. Lawrence County, New York, died May 22 at his home in Ogdensburg, at the age of 37. For a time after graduation from the Clarkson School of Technology at Potsdam, Mr. Howard was engaged with the United States Government Lake Survey and later was employed on construction work in New York City. He was appointed from the civil-service lists to the highway department, first being stationed at Oswego and then in Watertown, from which last town he went to the St. Lawrence County highway work.

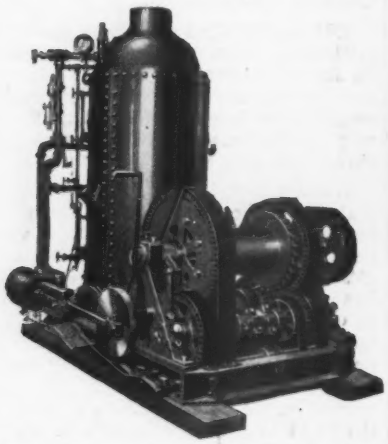
Robert S. Fenton, who served in the engineering department at Panama, died May 25 at the age of 39 years. Born in and a native of Philadelphia, Mr. Fenton was employed in St. Louis at the time of his death.

Appliances and Materials

Sheave and Drum in Steam Hoist Operate Independently

In a general-utility steam hoist recently put out, the sheave and drum are independent of each other so that they may be operated in opposite directions. Power may be applied through the sheave in either one direction or the other, irrespective of whether the main drum is hauling in the load or slacking off, thus permitting the handling of a material hoist at the same time as a separate hoist for reinforcing steel or lumber.

As it is a light-duty hoist, a cone clutch is used in the drum; and two



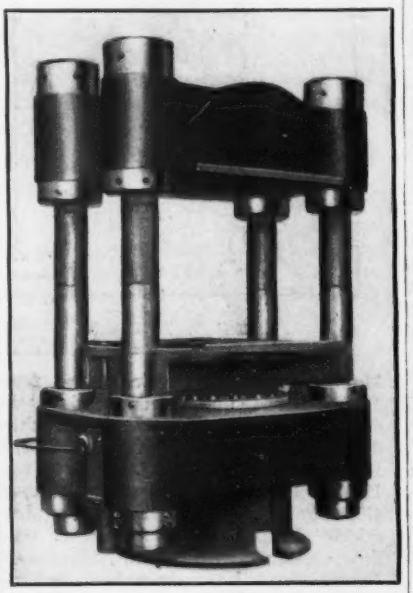
SHEAVE AND DRUM ARE SEPARATELY OPERATED IN COMPACT HOIST

smaller cone clutches, both operated by quadrants, give forward or reverse motion to the sheave.

The outfit is made in one size only, 5 x 6 in., by the Thomas Elevator Co., Chicago.

Hydraulic Metal-Forming Press of 1000 Tons' Capacity

The 1000-ton hydraulic press shown in the accompanying illustration has an adjustable space of 18 to 36 in. To provide for this, the upper ends of the strain rods are threaded; they are also fitted with threaded forged nuts, while the lower ends are made with solid heads and split collars. Both the upper and lower-strain-rod collars are threaded, the upper threaded collars serving



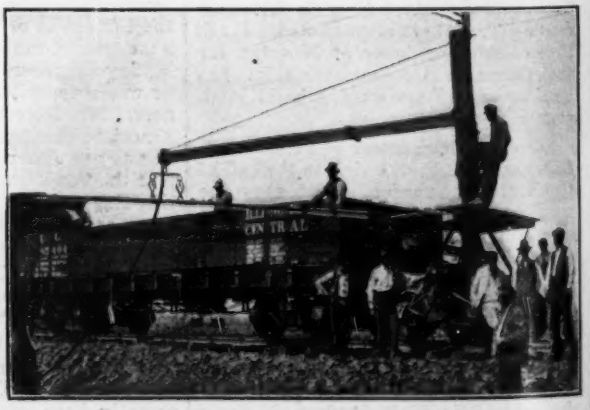
BOTH UPPER AND LOWER STRAIN-ROD COLLARS ARE THREADED

two purposes: First, to permit the head to be lowered; and second, to take up all clearance so that the head can be set perfectly true for close work. The lower collars are threaded so that all clearance may be taken up. The press is equipped with two auxiliary push cylinders, the purpose of which is to hasten the return of the press platen and ram after the pressing operation. These push cylinders are equipped with differential rams, the upper ends of which are smaller than the lower. This provides a shoulder on the rams in the cylinders and forms an area to take the water pressure for forcing the rams homeward. This press is of steel construction throughout, a large factor of safety being allowed in its design for the heavy pressure that it exerts, and it has a pressing surface of 42 x 48 in. It is made by the Hydraulic Press Manufacturing Co., Mount Gilead, Ohio.

Portable Crane Speeds Up Rail Laying

The portable rail-laying crane shown in the accompanying photograph was used last year in the construction of six miles of line of the Kankakee & Urbana Traction Co. in Illinois, writes T. W. Shelton, of Urbana, Ill., general superintendent of the company, in the "Electric Railway Journal." With it and a crew of 20 men, it was possible to unload rail from the car and lay it at the rate of ¾ mile per day.

The machine consists of a jib crane mounted on an ordinary freight-car truck, braced in the manner shown. The crane is operated by hand from a platform placed high enough to permit the operator to see all details of the operation plainly. A drawbar and coupler mounted on the crane pillar provide for connecting the crane car to the rail car. Mr. Shelton designed the machine and has been granted a patent on it.



RAIL-LAYING CRANE IS MOUNTED ON ORDINARY FREIGHT-CAR TRUCK